

SCIENTIFIC AMERICAN

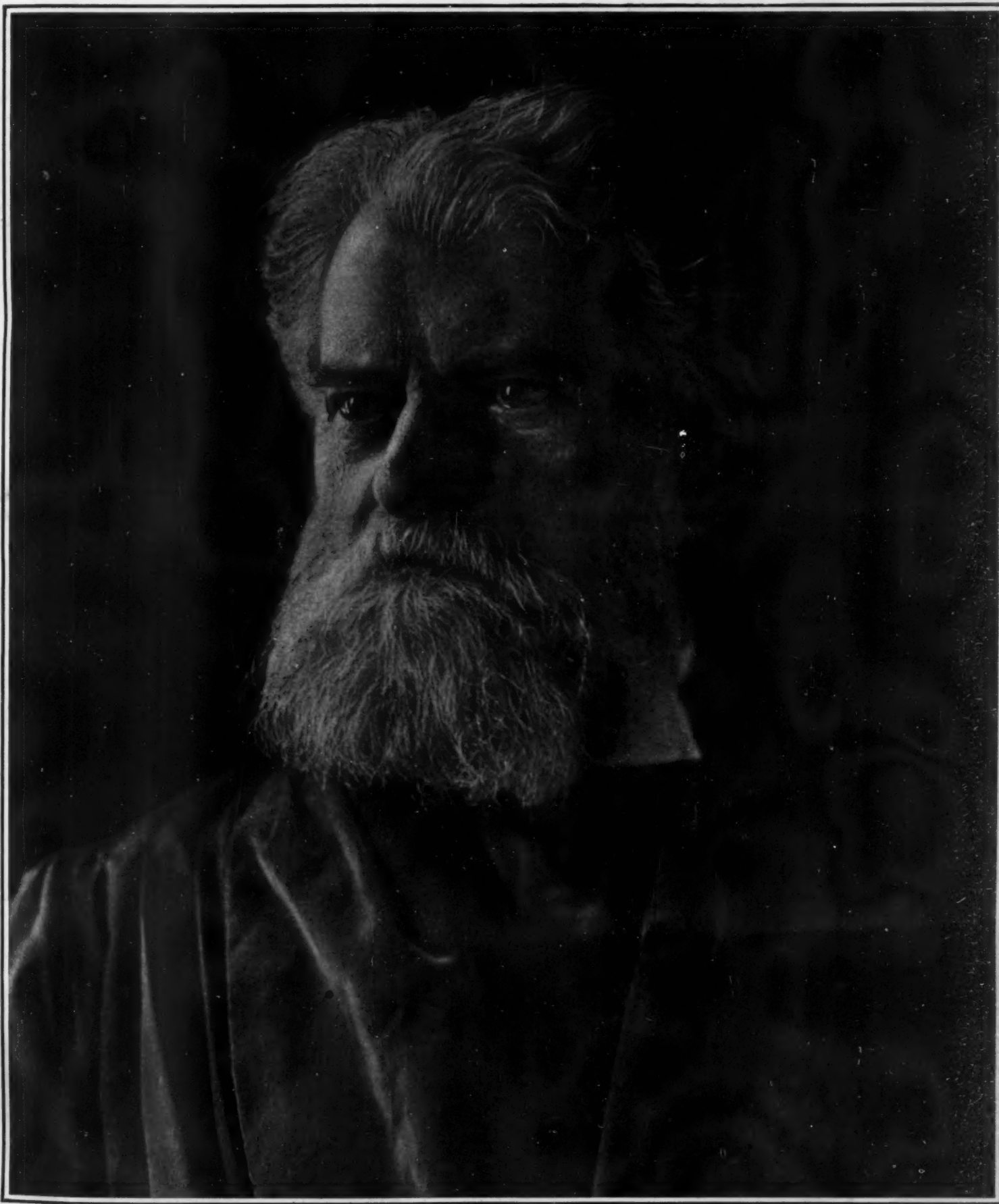
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Simon Newcomb

(See page 59.)

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NEW YORK, SATURDAY, JULY 24th, 1909.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are sharp, the articles short, and the facts authentic, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

CITY TERMINALS WITHOUT TRAFFIC CONNECTION.

The total lack of a co-ordinated plan (or shall we say of co-ordination of effort?) in the provision of transportation facilities in New York city, is forcibly brought to the notice of the public by a letter of Vice-President Rea, of the Pennsylvania Railroad Company, to Chairman Wilcox of the Public Service Commission, which draws attention to the fact that when the Pennsylvania's new station at Seventh Avenue and 33rd Street, New York, is opened to the public in the summer of 1910, it will be without any connection with the rapid transit system of the city.

The predicament in which the magnificent new terminal will find itself has its parallel in the history of the three great bridges across the East River. The Williamsburg Bridge stood, for several years after its completion, completely isolated from the elevated railroad systems of Manhattan and Brooklyn; and it was only recently that the costly elevated approaches to, and roadways on, the bridge were placed in service. The great Queensboro Bridge, opened a few months ago, is likewise without any rapid transit or elevated railway connections; and the present indications are that the new Manhattan Suspension Bridge, which will be completed within a year, will find itself in the same predicament. The case of the new Pennsylvania terminal will be particularly aggravated, since it will not only bring all the express trains of America's greatest railroad into the city, but it will also serve as the gathering and distributing center for a large suburban travel from New Jersey and from the extensive and populous residential districts of Long Island.

Obviously the most satisfactory plan for placing the Pennsylvania terminal in immediate touch with the subway system would be to build an extension of the existing subway south from 42nd Street through Seventh Avenue to the Battery. This is the plan advocated by the Pennsylvania Company; and as far back as 1906 such a route was laid out by the old Rapid Transit Commission as part of a complete system through Manhattan and the Bronx, the northerly portion of which was to be built up Lexington Avenue from 42nd Street to provide the east side with greatly needed facilities. This route is endorsed by the present Public Service Commission. The failure to build the line must be laid at the door of the Interborough Company, which operates the present subway; for it was not until last June that the offer of this company to construct such a line was received by the Commission, who have the proposal now under consideration. The traveling public has no interest in the controversy as to where lies the responsibility for the delay; but it is tremendously interested in having this line constructed with the least possible delay. We are well aware that there are other rapid transit routes before the Commission, for each of which their particular sponsors claim special advantages and the necessity for immediate construction; but in view of the importance of the new Pennsylvania terminal as a distributing center and of the pressing need for another four-track line south from 42nd Street to the Battery, we believe it will be the consensus of opinion that this line should be one of the first, if not the very first, to be authorized, and that the contractors and the Public Service Commission should join hands in rushing it to an early completion.

MAGNITUDE OF WORK ON NEW STATE BARGE CANAL.

The stupendous engineering work which the United States government is carrying through at the Isthmus of Panama so completely fills the public eye, that very little is heard of that other great work of canal construction, which is being executed in our very midst

in the enlargement and reconstruction of the old Erie Canal between Buffalo and Albany. Certainly but few people outside of professional circles are aware that in point of magnitude of excavation the figures for the New York State Barge Canal rival, if they do not exceed, those of the Panama Canal. Admitting that there can be no comparison on the score of accommodations between a canal twelve feet in depth and one with a maximum depth of forty-five feet, it should not be forgotten that whereas the Panama Canal from shore line to shore line is but forty miles in length the New York Barge Canal extends for nearly four hundred miles. Furthermore, the latter work involves the construction of thirty-four dams, fifty-three locks and seven guard locks, the construction of which is complicated by the fact that the canal, being built through the most thickly populated section of New York State, the effect of these works on adjoining properties and water powers has to be considered and due precautions against damage taken, involving additional costs in time and labor.

It is in the comparison of the amount of excavation done, however, that the surprising fact is developed that the total amount of excavation and its equivalent in concrete structures, if compared for the same period of time, is found to be actually greater on the State Canal than on the national undertaking at Panama. Up to January 1st, 1909, the excavation on the Barge Canal amounted to 15,168,000 cubic yards, and if to this be added the concrete and other constructional work, the total cost up to that date reaches \$8,701,000. On the Panama Canal, up to January 1st, 1908, the total amount of material taken out amounted to 22,255,000 cubic yards, and up to that time practically no work had been done on the concrete structures. It is stated by the engineers that if the sum of money expended during the period under consideration on concrete and other structures on the Barge Canal had been paid for excavation at the prevailing rate, it would have been possible to remove an additional 10,417,000 cubic yards of material. This would have brought the total of excavation up to 25,585,000 cubic yards, which would have been equivalent to an increase of twelve per cent over the amount of excavation done on the Panama Canal during the same number of years of operation. It is only fair in connection with these figures, however, to bear in mind that the present rate of excavation in Panama is far more rapid than that on the State Barge Canal. This, however, does not invalidate the force of the above comparison, as showing the magnitude of the work now being done between Buffalo and Albany. It is greatly to be regretted that the canal enlargement was not planned on a more generous scale. When the canal is opened, the depth of twelve feet will appear to be pitifully insufficient, in view of the fact that by that time the construction of the new Georgian Bay Canal, which will provide a depth of 21 feet from the lakes to deep water on the St. Lawrence, will in all probability be well under way.

WIRE-WOUND VERSUS STEEL GUNS.

In these days of big-gun ships and long-range fighting, the gun as one of the offensive elements of naval warfare has taken on an importance greater than it ever held before. In the engagements of the future, which will be fought at ranges of from four to six miles, accuracy of aim and large remaining energies of projectile become of prime importance. The most effective big gun for the new conditions will be that which will strike the heaviest possible blow, at the greatest possible range, with the lightest possible shell, fired from the lightest possible gun. These ideal results, which can be obtained only in a gun of unusual strength for its weight, involve high powder pressures, great length of gun, exceedingly high muzzle velocity, and a temperature of the powder gases so high that it will necessarily induce rapid erosion. Abnormal powder pressures must be met, either by using more material in the gun, or by the use of steel of exceedingly high quality as to strength and toughness, or by some mechanical arrangement in the building up of the gun, which will secure the needed strength with a minimum amount of weight.

Never was it more true than to-day that the battles of the future will be won by the big gun. If the ten or twelve great pieces mounted in their several turrets are unable to fire their eighty or one hundred rounds apiece with accuracy and without diminution of energy; if there be an unusually rapid erosion; if they show longitudinal weakness and begin to droop at the muzzle; or if, as has often happened in the past, the muzzle and chase of the gun are blown bodily away, the ship that carries those guns will go down to a sure and terrible defeat. Unable to reach the enemy because of the falling velocity of her own guns, she will continue to be subject to the pitiless accuracy and armor-piercing energy of the enemy's shells, and the unequal combat can have but one issue.

There are two leading systems of gun construction, the wire-wound system, which is used by Great Brit-

ain and Japan, and the solid-steel system, which is used by all of the other leading naval powers, including our own. At the time the wire-wound system was adopted by the British, gun steel for hooped gun construction had not reached the high pitch of excellence which characterizes it to-day; but with improvements in furnace practice and working in the mills, it has become possible to turn out a quality of steel which the German, French, and American manufacturers claim produces a gun equal, weight for weight, to the wire-wound gun—a gun, moreover, which is simpler to build, and in some respects more reliable and less likely to serious injury in an engagement.

In view of the above facts, a recent lecture before the Junior Institution of Engineers, London, by Lieut. Dawson, in which he goes very thoroughly into the question of the relative merits of wire-wound and solid steel guns, is of timely interest; since it shows why, in spite of the acknowledged improvements in the manufacture of hooped guns, the English artillerymen still prefer to build those of the wire-wound type. The chief advantage of the latter system, according to Lieut. Dawson, is that a uniformity of stress is attainable throughout the whole of the material employed in the gun structure, to an extent that is impossible in a gun built up of steel hoops only. Weight for weight, the wire-wound gun is the most efficient. The uniformity of stress is due to the fact that the wire is wound on at the theoretical tension necessary to obtain from every layer the maximum resistance when the gun is fired. Furthermore, the breaking stress of the wire now used is no less, than twice as great as that of the best forged steel available for solid steel construction, the breaking stress of gun steel being from 34 to 44 tons to the inch, as against a stress of 90 to 100 tons for the wire. By regulating the tension in the successive layers of wire during construction, the resisting strength of the steel is obtained to a degree that it is not possible to get by shrinkage. Lastly, because of its small cross section, the wire is more likely to be free from minor defects; since it can be inspected and tested throughout its complete length. So much for the constructional advantages.

In the completed gun there is the advantage that if the inner tube of a wire-wound gun fails, it is still possible to continue firing without danger; whereas, splitting of the inner tube of a built-up gun renders the weapon immediately useless. Should a flaw occur in a tube or hoop there is great danger of such flaw extending until complete rupture occurs. In a wire-wound gun, on the other hand, a rupture in any coil cannot spread to adjacent coils. Again, should a large explosive shell burst in the bore, the wire construction, according to Lieut. Dawson, will prevent the explosion doing serious damage to the turret. It is possible, when a wire-wound gun becomes badly eroded, to reline the piece and render it nearly as good as new, a feat which is more difficult in solid steel guns. The increase in the power of the gun, due to the introduction of the wire-wound system and to the vast improvement in the quality of gun steel for hooped guns, is shown by the fact that the energy of the British 12-inch gun has risen from 18,200 foot-tons in 1895 to 53,045 foot-tons in the new 50-caliber gun which will be ready in 1910; while the corresponding penetration of wrought iron at the muzzle of the gun has risen in the same period from 24.5 inches to 52 inches, this last being the muzzle penetration of the new 1910 pattern.

BURGLAR-PROOF GLASS.

Consul William Bardel of Rheims reports that a new French plate glass has been brought out which is practically burglar-proof. While an ordinary plate glass, such as is usually put into jewelers' show windows, can be smashed by a single stroke of a metal-faced mallet, it is not possible to break this new plate glass in this manner. In an experiment made, a large piece of cast iron was thrown violently against the window, but the only effect on the glass was a small hole measuring one or two inches. Several shots of a revolver loaded with jacketed bullets were then fired at the show window, but the window suffered no damage except that the bullets entered to a depth of a fraction of an inch. The plate glass which will stand such usage is ordinarily made of a thickness of $\frac{3}{4}$ to 1 inch. If desired, even a heavier glass can be made without diminishing the transparency.

In order to do away with attending to exhausted batteries of door-bell systems, a transformer has just been put on the market which enables one to obtain the current from the city mains. The transformer will operate on the ordinary lighting circuits. As it has no moving parts, once fixed it will thereafter require no attention. It is adapted to operate on circuits running from 100 to 130 volts, and is provided with taps giving 6, 12, and 18 volts, so as to meet the requirements of various styles and sizes of bells and buzzers.

AERONAUTICS.

Those members of the Aeronautic Society who have completed and tried out their machines have not met with good luck of late. A week before the exhibition of June 26th Wilbur R. Kimball damaged his eight-propeller biplane by hitting the banked part of the track at one of the turns, and last week Frederick Schneider demolished his Wright-type aeroplane, which was fitted with the society's motor, when it was shot off the catapult. Both of these members, nothing daunted, intend to build new machines. The Beach-Willard monoplane is nearly completed and will probably be tried by Mr. Willard within a few days, as soon as he has learned how to fly the Society's new biplane.

Senator Henri Deutsch de la Meurthe, who has probably done more than any other one man to encourage the development of aeronautics by offering generous prizes, has recently given \$100,000 for the founding of an aero-technical institute in connection with the Paris University. The new institute will be named after M. Deutsch, and will be devoted to study and research for the purpose of perfecting flying machines of all types. M. Deutsch has also given \$3,000 and the University \$2,000 annually to carry on the work. M. Basil Zaka-roff, a wealthy Greek resident of Paris, has given \$140,000 for the founding of a chair of aviation by the Faculty of Science at the University. These two gifts show the generosity not only of the native Frenchman, but of the foreigner who has made France his adopted land, when the two meet in the common field of science.

The "Zeppelin I"—the German government's first Zeppelin airship—recently made the trip from Friedrichshafen to Metz. The former place was left at 12:27 A. M., June 29th. There was a light northwest wind blowing. Ravensburg was passed at 1:07, the airship continuing northward at about 18 miles an hour. At 4 P. M. a landing was made in a field at Biberach because of bad weather and trouble with the motors. Despite a heavy rain, the crew of eight men brought the huge craft safely to earth. A battalion of soldiers was required to hold it the next day, when the wind blew a gale. Repairs were finally effected and the airship at length reached its destination on July 4th. After another of the latest-type "Zeppelins" is completed for Metz, the "Zeppelin I" will be sent to Tegel, near Berlin, as a school ship. The official report of the recent long-distance trip of the "Zeppelin II" will be found in the current SUPPLEMENT.

A faint idea was given New Yorkers last week of what a modern dirigible could do in the way of passing over their city, when Frank Goodale sailed his tiny airship from Palisade Park, on the west bank of the Hudson opposite 130th Street, across the river and above Broadway to 42nd Street. The craft, under perfect control and making about 12 miles an hour, circled around the Times Building and returned to its starting point in 40 minutes. A large modern dirigible, with a speed three times as great and a carrying capacity of a score of passengers, could have made this trip in much less time, even with quite a wind blowing. M. Clement, of Paris, is at present constructing just such an airship with the idea of crossing to England. Some patriotic British newspapers are constructing a shed for it at Aldershot with the hope that after this craft has demonstrated its capabilities the government will purchase it and thus acquire a large up-to-date dirigible.

Orville Wright, in attempting to fulfill the government requirements at Fort Myer with his aeroplane, has met with numerous set-backs and a great deal of ill luck. Owing to trouble with the motor and unfavorable winds, the first flight, consisting of one circuit of the field, was not made until June 29th, and then only at the third attempt. The next day the machine flew the length of the field, but scraped one end of the lower plane in making the turn, and in landing broke one runner. On July 2nd two flights were made of 7 and 12 minutes, the second being terminated by the stopping of the motor when the machine was over the shed at the end of the field. In landing one end of the lower plane caught on a small tree, which tore the cloth and whirled the machine around, completely demolishing the runners. Ten days were taken to repair the machine, and it was not until the 12th instant that Orville Wright succeeded in flying again. This flight lasted 5 minutes and 38 seconds. The next day the machine failed to rise properly, and but two straight-line jumps of less than half a minute were made, a runner being broken in alighting the second time. Although a large crowd of prominent people visited the parade ground every afternoon last week, conditions were generally said to be too unfavorable for a flight, and aviation in the vicinity of the national capital received a sharp set-back as a result of the failure of the Wright machine to fly under what could hardly be called really unfavorable conditions, such as a light wind of 6 or 8 miles an hour for example.

ELECTRICITY.

A large Mexican hydro-electric company has just been organized for the purpose of furnishing the power for a vast irrigation scheme. A large plant is to be built near Lake Chapala, and another on the Santiago River near Guadalajara. The territory which is to be reclaimed by this irrigation system covers more than 500,000 acres.

The success of the electrically-illuminated baseball grounds at Cincinnati, Ohio, has been so pronounced, that it is now proposed to have football games, as well, on the illuminated field. Football is too strenuous a game to be played under the summer sun, but no such objection can be raised to it in the cool of the evening or night. It is expected that quite a number of outdoor sports and games will now be possible for evening entertainment.

Last year \$56,000,000 was spent by the railroads of the United States for cross ties. The average price of the ties was 50 cents each. Only six per cent of the ties was used by electric railroads. Forty-three per cent of the ties were of oak, and nineteen per cent of yellow pine. Owing to the growing scarcity of suitable timber, other woods are being used after treatment with various preservatives, and it has been found that these treated woods outlast the more expensive untreated oak ties.

In a talk given before the Electric Club of Chicago, Mr. Edward N. Lake pointed to the remarkable growth of street railway systems in the United States. Of the 8,123 miles of single-track railways in 1890, only 15.5 per cent were operated by electricity. At the beginning of last year there were 34,404 miles of street railway, 34,060 miles, or 99 per cent, of which were electrically operated. Mr. Lake also pointed to the rapid strides now being made in the electrification of steam railroads, and predicted great progress within the next ten years.

A new type of electro-magnetic brake is being manufactured in Germany, which operates on the rails rather than on the car wheels. This rail brake comprises a pair of pole shoes, which are parallel with the rails and located close to them. The braking effect may be increased by lengthening the pole shoes. The weight of the brake is but three per cent of the pressure it exerts. The brake is adapted particularly for mountain railroads, and may be used in conjunction with an ordinary wheel brake to increase the adhesion of the car to the rails.

Early in June an outdoor theater conducted by the Boston Suburban Electric Railroad at Auburndale-on-the-Charles was burned to the ground. The fire was discovered at 2 o'clock in the morning, but the general manager was on the scene inside of twenty minutes. A telephone station was immediately established, and within two hours a designing engineer was on the ground planning a new structure. An hour later the carpenters and contractors arrived, ready to estimate the cost of reconstruction. By this time the ruins were cool enough to permit of starting work, which was rushed through with such celerity that within ten days a brand-new theater, complete in every detail and seating three thousand persons, was ready for use. Credit for this rapid construction is due almost entirely to the telephone, which was in constant use during the ten days of construction.

It is well known that Hertzian waves can be transmitted more readily over water than over land. The reason for this was explained quite recently by Prof. J. A. Fleming in a popular lecture. He showed that a current of high frequency could be transmitted over a galvanized-iron wire as readily as by means of a copper wire, but that if the zinc was burned off the wire, so that the current had to traverse an iron path, there was a considerable reluctance. This showed that high-frequency currents, which normally travel over the surface skin of a wire, will penetrate farther into the metal of low conductivity. The Hertzian waves do not penetrate water to a depth of more than a few feet, but when traveling over dry soil there is a much greater penetration, due to the poorer conductivity, which results in a greater loss of energy.

An electric railway running from Trient to Malé, Austria, a distance of 38 miles, is soon to be put into operation. The current is to be supplied by a hydro-electric plant. This marks an important step in the utilization of water power in the Tyrol. Another railway line is nearing completion in Austria, known as the Maria Zell road. This line is 57 miles long, and is the longest single-phase railway in Europe. The current is furnished by a hydro-electric plant, and is fed to the trolley wire at a pressure of 6,000 volts. The catenary system is used for supporting the trolley wires. The locomotives will each be equipped with two single-phase 250-horse-power motors. Owing to the narrow gauge, the motors cannot be mounted on the car axles, but are situated above the trucks and connected to the wheels by means of connecting rods after the manner of a locomotive.

SCIENCE.

"Orthodontist" is the technical name of a new kind of dentistry. In plain English, "orthodontist" means "tooth-straightener." According to last accounts, there are about 60 of him now in America, as compared with 50,000 ordinary dentists. To the orthodontist's mind, a man who extracts a tooth in regulating foolishly clings to old tradition. He holds that the properly-shaped jaw can hold all the teeth that grow.

Mr. C. E. S. Phillips exhibited at the recent *conferenza* of the Royal Society a permanently luminous watch dial and military night compass. The watch dial is transparent (glass) and the figures are painted upon its upper surface. The dial is backed with a compound containing a minute quantity of RaBr₂ (radium bromide), which renders it luminous, so that the time may be easily read in the dark. The compass is arranged upon the same principle. By means of a luminous disk and strip, direction may be determined at night.

A series of ascents of kites and balloons on Lake Victoria was organized by the Prussian Aeronautical Observatory of Lindenberg in July, 1908. A registering balloon, which attained the height of 19.8 kilometers, recorded, at that altitude, a temperature of -84 deg. C., a lower value than has ever been found at equal or even greater altitudes over Europe. The "isothermal layer" was entered on several occasions. On several occasions also an uppermost current from the west was found above the regular easterly current of the equatorial region.

It was shown by the N. S. W. Royal Commission on the Spontaneous Combustion of Coal Cargoes (1897), that ships whose cargoes took fire had mostly been loaded in summer. In view of the high summer temperature of Newcastle, N. S. W., this was only what might have been expected; but it does not seem to have been noticed that a similar relation might obtain for cargoes loaded in the temperate climate of the United Kingdom. Prof. Threlfall has made an analysis of 4,898 long-voyage shipments in the years 1873, 1874, and 1875—presented to the English Royal Commission of 1876—which analysis shows unmistakably that it is only cargoes loaded in summer which are liable to spontaneous combustion.

A new process of keeping eggs consists in placing them first in compressed carbon dioxide, which almost completely sterilizes them, and then in a mixture of carbon dioxide and an inert gas (nitrogen and hydrogen) at a temperature near the freezing point. In these conditions the micro-organisms which have not been destroyed cannot develop. The addition of the inert gas is necessary in order to prevent the liquefaction of the albumen, which would certainly occur in an atmosphere of pure carbon dioxide. Eggs thus treated can be kept ten months without losing any of their qualities. The treatment costs about 38 cents per thousand eggs, while cold storage costs 13 cents per thousand per month; hence if the eggs are kept nine or ten months, the former process will be much cheaper than the other.

A French commission formed for the purpose of making comparative studies of the vertical and inclined styles of handwriting, with regard to the health of school children, has unanimously reported in favor of the inclined style, which is asserted to be far simpler and less fatiguing than the vertical style, and less likely to cause spinal curvature and other evil results. In writing by the vertical system, the right arm is held in an unnatural position, which makes it impossible for the child to maintain a normal and hygienic posture. Vertical writing is performed very slowly and laboriously and may seriously injure children who are predisposed to spinal curvature and other deformities or to writer's cramp. The oculist of the commission denies that vertical writing presents any advantage over inclined writing with respect to the prevention of short-sightedness.

At a meeting of the horticultural society of Algeria, last November, a number of seedless dates of large size and fine flavor were shown, which had been produced without artificial fertilization. The date palm (*Phoenix*) is a dioecious plant, the male and female flowers being borne on separate trees. No seed can be formed unless pollen is conveyed from the male to the female flower by wind, insects, or human agency. In Algeria pollination is usually assisted by placing a few male flowers, with ripe pollen, among the female flowers. Egyptian paintings show that this method was practised in antiquity. Seedless fruits have often been produced by isolated female trees but hitherto these seedless dates have been imperfectly developed. At Nice is cultivated a species of date palm which produces black fruit and bears abundantly every year, whether the flowers are fertilized or not, the seedless dates being equal in size and flavor to the normal fruit. In most species, however, the seedless dates are smaller and are produced less abundantly than the normal fruit.

SOME EXPERIMENTS WITH AN ORANGE.

BY PROF. GUSTAVE MICHAUD, COSTA RICA STATE COLLEGE.

Experimenters in need of chemicals may sometimes do without the druggist. The soil, plants, animals, are but chemical laboratories; in one orange, chemicals are found in such a number and of such a nature as to enable anyone to perform several curious experiments. Most of the readers of the *SCIENTIFIC AMERICAN* probably have read about or used the sympathetic ink which is obtained by merely dipping a pen into the juice of the fruit. The sudden apparition, on the heated paper, of the hitherto invisible script is one of the pretty experiments which can be made with orange juice. Those which the writer is about to describe have more to do with the physiological than with the strictly chemical properties of the fruit.

Sugar and a considerable amount of citric acid are found in a ripe orange. Besides the taste, a good proof of the presence of a true acid in orange juice can be had by boiling in water a few red cabbage leaves and then letting some orange juice fall into the bluish decoction. The instantaneous change from blue to red reveals the presence of acids even when taste fails. It may be a matter of surprise to many to learn that the strong sugar and acid flavor of orange juice cannot be perceived by a considerable region of our gustative organ. The middle anterior part of our tongue is as insensible to these two flavors as the *punctum cecum* of our retina is insensible to light. The fact was ascertained for the first time, I believe, by the scientist Schreiber, who carefully fixed the boundaries of the insensible regions of the tongue for many substances, among which were sugar and citric acid. The accompanying drawing shows that the unresponsive area corresponding to sugar does not coincide everywhere with the area of insensibility for citric acid, but it shows at the same time the existence of a large territory common to both. Cut a small piece of peeled orange. Express it slightly, so as to avoid the dropping and running of the juice over the tongue. Place it in contact with your tongue at nearly one inch from the tip. You will find the orange absolutely tasteless. Bring forward the same piece of orange on to the tip of the tongue, and the strong sugar and acid flavor instantaneously reappears.

It cannot be said that a part only of our gustative organ is insensible to the taste of the essential oil contained in the orange peel, for it is the whole tongue and mouth which do not perceive it. To say this while everyone knows the powerful aromatic taste of orange peel seems foolish enough, yet it is true. That particular taste is not a taste but a smell, perceived with the nose only, and many other sensations called tastes have not the slightest right to such a title. Yet the statement that such condiments as vanilla or peppermint are tasteless, is sure to arouse considerable opposition if you make it after dinner in a company of laymen. Ask the most determined of your contradistors to leave the room for a moment, and meanwhile cut into small pieces some of the outer, yellow peel of an orange, which you place into a spoon. Your opponent is then requested to close hermetically his nose, and to enter the room. When he is near the table, you ask him moreover to close his eyes, and to eat and name the spoonful of food you place into his mouth. As long as his fingers press his nostrils, no amount of chewing or swallowing will enable him to comply with the latter request.

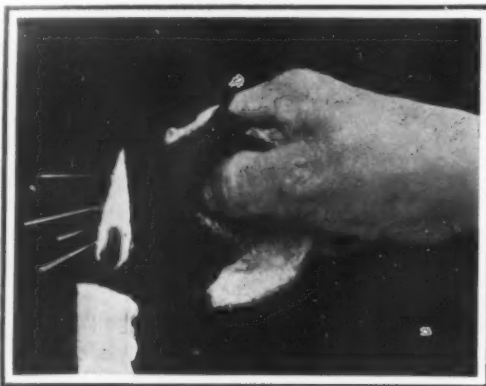
Yet it is not probable that any part of any plant is much richer in essential oil than the yellow epicarp of the orange. It is so loaded with the odoriferous liquid, that any change in its shape will produce tiny jets which spring in every direction. To observe these, light a candle and bring near it a piece of orange peel held between thumb and forefinger. Double and press the peel, the yellow side facing the candle, as shown in the photograph. Pretty streaks of fire will be seen to start from the candle up to several inches away from it. They are produced by the ignited jets of essential oil.

To prevent the drying out of gum Arabic, it is only necessary to place a small piece of camphor in the solution. The gum is not thereby impaired but remains adhesive to the last drop. Another method is to add a small addition of glycerine.

SOME NEW WARSHIPS AND THEIR EQUIPMENT.

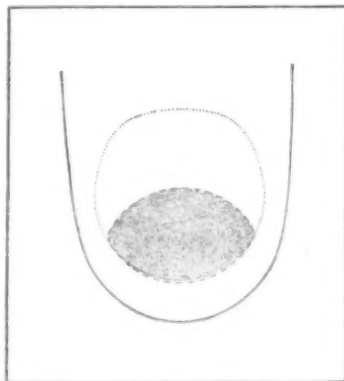
BY PERCIVAL A. HISLAM.

During the past two months a good deal of information has become available concerning the naval construction of various foreign powers, and this it is pro-



Streaks of fire drawn from an orange peel.

posed to summarize in the following brief paper. The British Admiralty is still very reticent as to the armament of the "Neptune" (laid down in January) and of the four battleships of the current year's programme, but it is generally understood that these



Some blind spots of the tongue.

Dots define region insensible to taste of sugar; dashes, region insensible to citric acid, and shaded region that insensible to orange.

five battleships will all be armed with the new 13.5-inch gun with which experiments have been made during the last twelve months. In some quarters it is doubted whether the gun will be in a sufficiently forward state to allow of its being mounted in the "Neptune," but its adoption in the four 1909 ships is regarded as certain. None of the ballistics of this gun has been allowed to become public, but its shell will weigh 1,250 pounds, or 400 pounds heavier than

most of the German ships of the "Dreadnought" type, of which ten are now under construction. The British Admiralty last year stated that the first four would carry twelve 11-inch and twelve 6.7-inch. This year an official (British) statement places the main armament at the same figure, but gives twelve 6-inch guns as the secondary armament.

This has recently been confirmed by the German government. Much uncertainty, however, still exists as to the armament of the six later German "Dreadnoughts." Fighting Ships, a usually reliable naval annual, states that they will have twelve 12-inch guns divided between four turrets. It should be noted, however, that although this plan is stated to have been obtained from an official model, the remark is added that "it is not impossible that one of the middle turrets may be suppressed, and the ships carry only nine 12-inch, or even only eight." Sketch plans of the "Rheinland" and "Posen" (sisters to the "Nassau" and "Westfalen") and of the later ships, are given in the accompanying plan.

It is now certain that the armored cruiser "Blucher" will carry twelve 8.2-inch guns (242-pound shell), and the British Admiralty credits her with a secondary armament of eight 5.9-inch. It is impossible to obtain any confirmation of the secondary armament, and those who have seen the vessel say that there is no provision for the mounting of such weapons. Twenty 24-pounders are given as the alternative. She will have a six-inch belt and a speed of 23.5 knots, with triple-expansion engines of 35,000 horse-power. The "Von der Tann," the first of the real German "Dreadnought" cruisers, which will be completed this year, will carry either eight or ten 11-inch guns. The "G" and "H" of later programmes, will carry ten guns of this caliber disposed as in the "Dreadnought." Their main belt is 7 inches thick, and their speed with Parsons turbines of 45,000 horse-power, 25 knots.

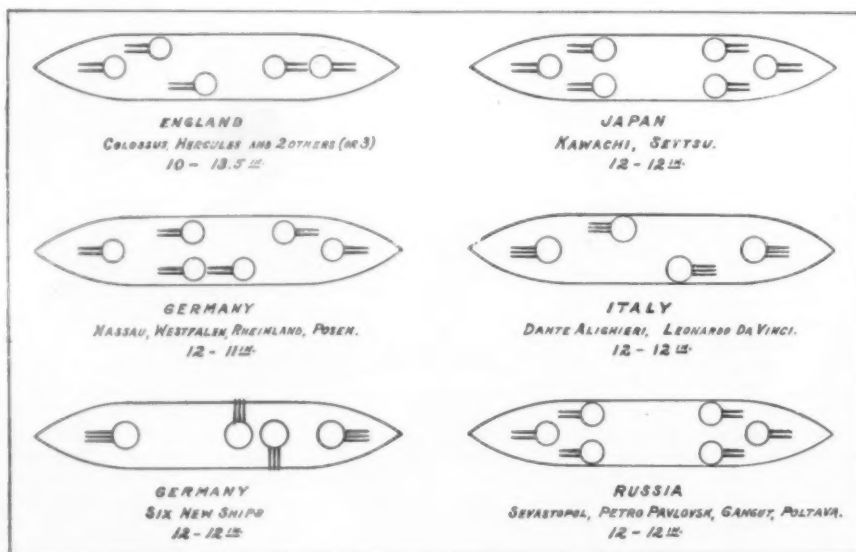
The new scout-cruisers building for the German navy will be of 3,800 tons and will carry fourteen 4.1-inch guns, the speed being 26 knots.

The Japanese battleships "Aki" and "Satsuma," which were laid down in 1905, will not be completed before 1910. They are the first battleships to be built in Japanese yards, and the experience, although doubtless of great value, will have been dearly bought. The "Satsuma" is of 19,350 tons and is armed with four 12-inch, twelve 10-inch, and twelve 4.7-inch guns, while the "Aki," 450 tons larger, will have eight 6-inch instead of the 4.7's. Two new ships have just been laid down, the "Kawachi" at Kure on January 18th and the "Settsu" at Yokosuka on April 1st. On a displacement of 20,800 tons they will carry twelve 12-inch, ten 6-inch, and twelve 4.7-inch guns. The "Jiji Shimpo," a Japanese paper, gives only ten 12-inch, but the heavier armament is fully confirmed. Fighting Ships gave these vessels fourteen 12-inch, the end turrets containing three guns apiece, but the design, although produced, was abandoned. The armored cruiser "Kasuga," by the way, has had her single 10-inch gun replaced by two 8-inch, and now is similar in all respects to the "Nisshin." The new 1,150-ton destroyer "Umikaze," built at Maizuru, has completed her trials successfully, easily maintaining the desired speed of 35 knots. Her engines are of 20,500 horse-power (turbines).

No new vessels have been commenced for the French navy since July of last year. Italy, however, has ordered two battleships of approximately 20,000 tons, their names being "Dante Alighieri" and "Leonardo da Vinci." They will have turbine engines of 30,000 horse-power and a speed of 22 to 23 knots, while their armament will consist of twelve 12-inch guns mounted in four turrets and disposed as shown in the illustration. The secondary battery comprises eighteen 4.7's. Two other battleships are shortly to be ordered, and while their armament may follow that of the earlier vessels it is also rumored that, in accordance with the proposals of Col. Vittorio Cuniberti, the distinguished naval constructor, they may carry eight 14-inch guns of a new type. This burst of activity on the part of Italy is due to the fact that the Austrian government has recently embarked on a four-"Dreadnought" programme, the vessels to carry ten 12-inch guns and to steam 23 knots with engines of 30,000 horse-power.

The reconstruction of the Russian navy has at last commenced for the French navy since July of last year.

(Concluded on page 59.)



LATEST "DREADNOUGHT" DESIGNS OF THE NAVAL POWERS.

the shell of the 12-inch gun which now forms the main armament of most battleships. Ten of these guns will be mounted, their disposition being shown in the accompanying plan.

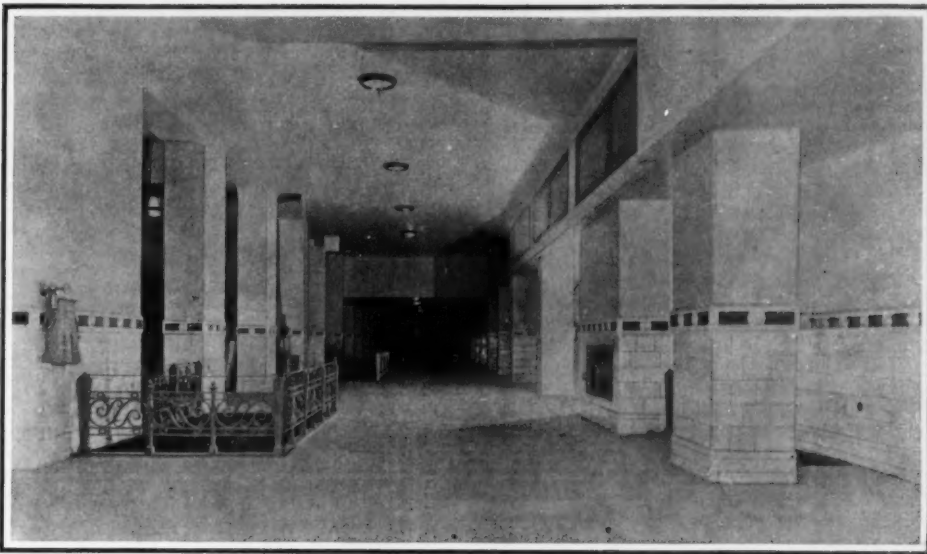
Much uncertainty still exists as to the armament of

OPENING OF THE DOWN-TOWN HUDSON TUNNELS.

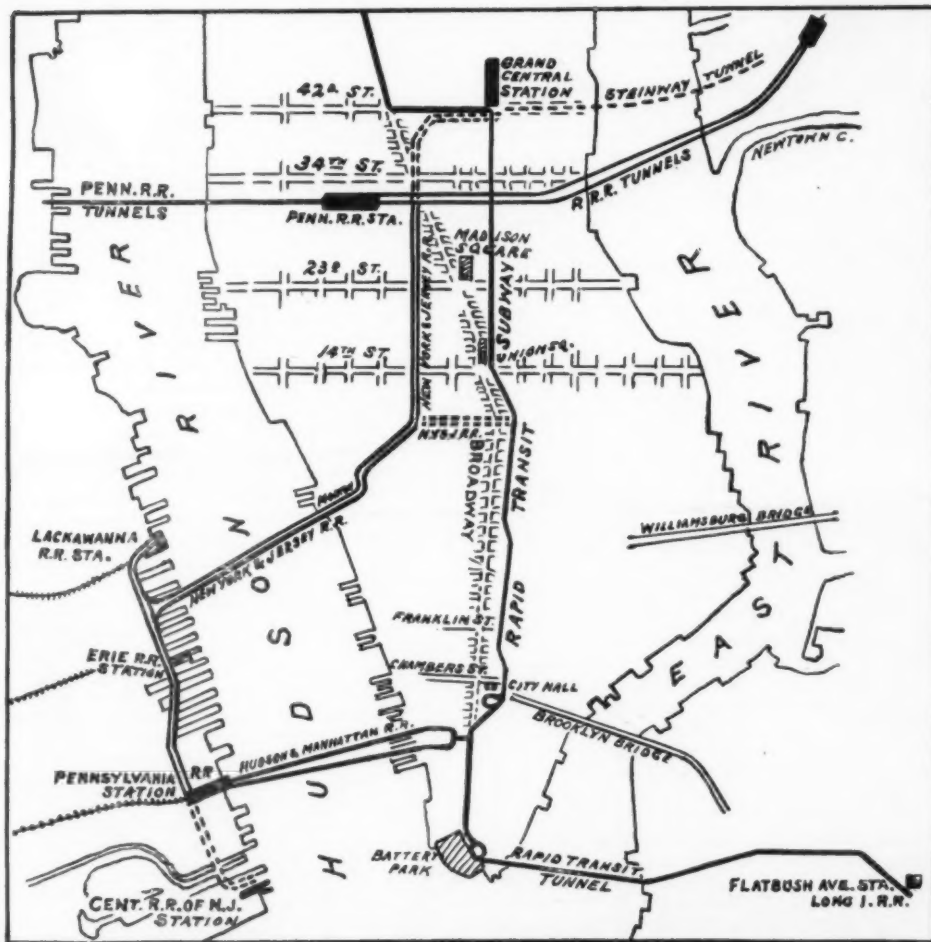
The opening to public traffic of the immense passenger station of the Hudson & Manhattan Railway, the terminus of the down-town pair of the Hudson Companies' "tubes" under the Hudson Terminal Building, marks a further step in the expansion of this great inter-urban transportation system.

When first a sub-aqueous connection between New York city and New Jersey was projected by Haskin thirty-five years ago, his scheme was by many considered visionary; but the tributary system of tunnels already completed or immediately projected, not to mention its possible further extensions, all the outgrowth of the original Hudson tunnel, would have been beyond his wildest dreams.

The first Hudson tunnel was commenced in 1874, and suffered many vicissitudes before its completion, passing through the hands of four different operators. After being abandoned for eight years, excavation was resumed and notable progress made by an English company in 1891, by methods not essentially different from those by which the tunnel was eventually completed, and after extending the tunnel to 4,000 feet from the Jersey shaft, they abandoned the project only through lack of funds. The enterprise of Mr. McAdoo supplied the latter, and in 1902 the New



VIEW OF CONCOURSE, LOOKING NORTH ON WEST SIDE.



PLAN OF HUDSON COMPANIES' SYSTEM AND CONNECTIONS.

York & New Jersey Railroad Company took up the work under the direction of Mr. C. M. Jacobs, who had done remarkable pioneer work of the same sort in the East River gas tunnel, and in March, 1905, successfully drove into the New York workings the northern of the pair of tubes into which the original single tunnel had been divided. The actual completion of a traversible roadway under the Hudson, the long anticipation and many failures of which had made investors skeptical, greatly facilitated the financing of an expanded project. Alliance was made between the New York and New Jersey Railroad Company and the Hudson & Manhattan Railway, which had already projected tunnels from the Pennsylvania station in Jersey City and Cortlandt Street, and connecting lines along the Jersey shore and terminal extensions in New York were planned, which are best understood by reference to the accompanying map. A complete history of the system and description of its methods of excavation, fully illustrated, was given in our SUPPLEMENT of February 29th, 1908.

It is the last-mentioned pair of tubes from Jersey City to Cortlandt Street that have now been opened to the public, providing, as will be seen from the map, direct communication from the heart of the financial district to the Pennsylvania, Erie, and Lackawanna railroads, while passengers from New Jersey will also be able to step directly into trains of the Interborough subway for uptown Manhattan and the Bronx or Brooklyn.

When the extension now authorized is completed, via stations at Sixth Avenue and 39th Street and Fifth Avenue and 42nd Street, to a terminal station between Lexington and Park Avenues, further connection will be made there with the Interborough subway, Grand Central Station, and the Steinway tunnels to Long Island, in addition to the connection at 33rd Street with the new Pennsylvania Station and its main line service to the West and South and to Long Island.

The newly-opened twin tunnels diverge slightly as they leave the Jersey shore, entering New York under Cortlandt and Fulton Streets, between which is situated the Hudson Terminal Building, the largest office building in the world, accommodating twenty-five thousand persons and carrying in its thirty-nine elevators between thirty and forty thousand passengers a day.

Inclosed in the eight-foot thick solid concrete foundation of this building, 75 feet deep, 180 feet wide, and 420 feet long, is the three-story station just opened. Inclined planes, stairways, and elevators lead from the street level to the "concourse," a handsome apartment, brilliantly lighted, with vaulted roof, finished in white glazed tiles, relieved with terra cotta, containing waiting rooms, telegraph and telephone rooms, the ticket offices of three New Jersey railroads, restaurant, barber shop, and all the conveniences of a large railway station.

Special provision has been made for women in the way of rest and recreation rooms with uniformed maids in attendance, and it is suggested that shoppers arriving from the Jersey suburbs may do all their shopping without leaving the building. Leading retail stores in all lines have taken space in the concourse, and an elaborate system is provided for the ordering of goods from up-town by telephone, parcels being received at a special department and kept till called for by home-going husbands from down town in the evening.

The color scheme of the concourse is white and green, all the iron and wood work being of the latter color, which is restful and refreshing to the eye. The only defect is a somewhat excessive display of advertisements, which, in order to serve its purpose in catch-

(Concluded on page 59.)



TRAIN LEVEL AT HUDSON TERMINAL, LOOKING NORTH ON WEST SIDE.

THE THIRD HONORABLE MENTION ESSAY IN THE FOURTH DIMENSION COMPETITION.

BY "CHARLES HENRY SMITH" (CARL A. RICHMOND, CHICAGO, ILL.)

[It was one of the conditions of the Fourth Dimension Competition that the editor of the SCIENTIFIC AMERICAN reserved the right to publish those essays which were considered worthy of honorable mention. In accordance with that condition, the essay which in the opinion of the judges, Profs. S. A. Mitchell and H. P. Manning, was deemed worthy of third place in the honorable mention class is here printed.—Ed.]

A colony of bees housed in a hive with glass walls so that their every movement can be observed affords a very instructive lesson in natural history. Such a glass hive may also serve as a helpful illustration in a consideration of the fourth dimension. Let us imagine a hive with its floor and roof of horizontal glass plates brought so close together that there is barely room for the bees to move about between them, and, for the purpose of our illustration, let us endow the bees with the intelligence of men. To these bees, so confined, forward and backward, right and left, would be familiar ideas and their world would be one of two dimensions only. Debarred from upward and downward movement by the closeness of the glass plates, the words "up" and "down" would be meaningless to them because there would be no experience upon which to base these ideas. Imperfect as is the illustration, it suggests the conception of a world of only two dimensions, length and breadth.

Plane geometry is a science which deals with such figures as triangles, squares, and circles. It is interesting to know that it originated in Egypt where it was developed to facilitate the measurement of land. This origin of the science gave rise to the name geometry, which means earth measurement. Long subsequent to the era of its Egyptian development the science was extended under the name of solid geometry to a study of such figures as spheres, cubes, and cones.

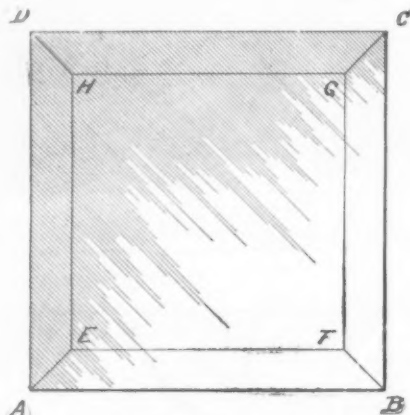
The bees in the glass hive could move around a square, could make triangles and circles, and to them plane geometry would be a practical science; but with their ignorance of an up-and-down direction, a cube or sphere would be inconceivable, and a third dimension would appear to them as absurd and unthinkable as a fourth dimension does to us. Suppose we lay two pencils on the table so as to cross one another at a right angle and then hold a third pencil so as to form right angles with the other two. While this is obviously a possible thing for us to do, it would be impossible for the bees with their ignorance of the dimension of height. They could, of course, have two slender pencils in their hive at a right angle to one another, but they could not have a third pencil at right angles to both of the first two. We may look upon the two pencils as representing the two dimensions of the world of the bees, and the three pencils as representing the three dimensions of our world. Suppose, further, that some one tells us to hold a fourth pencil at right angles with the other three. In our field of experience we can find no place for it, just as the bees could find no place in their field of experience for the third pencil. This fourth pencil represents the so-called fourth dimension. Although it is impossible for us to place it, the illustration of the relation of the bees to the third pencil or dimension teaches us that the limitations of experience ought not to be deemed conclusive as to how many dimensions space may have.

It is a matter of pure speculation as to whether there is such a thing as a fourth dimension, whether there are beings of intelligence to whom phenomena are manifested in the form of four dimensions. It is by no means the attitude of mathematicians to instantly recoil from the suggestion, but they are pleased to go ahead and study as accurately as possible under the necessary limitations what may be the properties of a space of four dimensions, if there is any such thing. The fundamental guiding principle of their investigation is this: Whatever they find to be the relations of geometry of two dimensions to geometry of three dimensions, they assume that there are similar or analogous relations between geometry of three dimensions and geometry of four dimensions. As the circle is to the sphere, so is the sphere to some unknown body, which may have its existence in space of four dimensions. As the square is to the cube so is the cube to a figure in space of four dimensions which we may call the "cuboid."

Of course the fourth dimension is intangible. Mathematicians do not ask us to imagine a fourth dimension, much less do they ask us to believe in it. It is not to be supposed that the most skilled student in this subject has a mental picture of four-dimensional space. Nevertheless, the properties and relations of figures existing in four-dimensional space may be investigated and stated.

Algebra is the science of numbers. It is a very efficient aid in the study of geometry. Algebra deals largely with equations such as $x + y = 12$, which means that x and y are two variable numbers that, multiplied together, give 12, as for example, 3 and 4 or 5 and 2.25. All the simpler figures of geometry such as the straight line and the circle may be represented

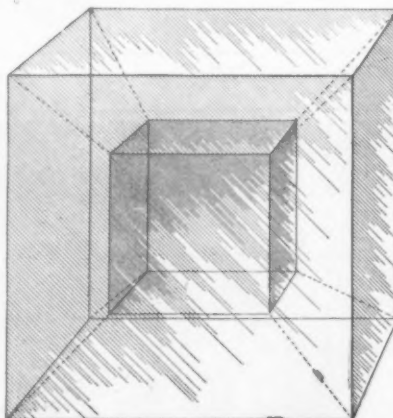
by equations; in other words, the equations are condensed descriptions of the respective geometrical figures, somewhat as a score-card is a condensed description of a base-ball game. Mathematicians have learned that the properties of geometrical figures can be studied far more readily by means of their equations than by means of the figures themselves. A mathematician who understands this mode of study can look at the equation of a curve and tell all sorts of interesting and useful properties of it without ever seeing the curve itself—indeed, without even having any mental picture of what the form of the curve may be.



Top view of a glass cube as seen with one eye: a three-dimensional figure appearing in one plane.

Without going into detail, it may be stated that one equation with two variable numbers represents a plane figure, thus $x^2 + y^2 = 15$ represents a circle. One equation with three variable numbers represents a figure in space, thus $x^2 + y^2 - z^2 = 0$ represents a cone. What does one equation with four variable numbers represent, say, for example, $x^2 + y^2 + z^2 + w^2 = 20$? By analogy, we should say a figure in space of four dimensions. Although we cannot imagine such a thing, we can pursue our analogies and study this unreal figure by means of its equation, and thus we can deduce many of its properties. The difference is simply this: whereas, when we study the equation of a cone, we can always turn to the real cone and interpret our results thereon, when we study an equation of a four-dimensional figure we have to be satisfied without such an interpretation. In other words, although our geometry halts with three dimensions our algebra marches on to any number of dimensions and is a stimulus to imagine a geometry of more than three dimensions.

We will now outline briefly a way in which algebra may help to give a person some faint notion of a figure having four dimensions. It is somewhat common to study a figure having three dimensions by means of equally spaced parallel sections thereof. For example, if the microscopist wants to study the shape and structure of a germ cell, he slices off exceedingly thin sections and arranges them in succession on a glass slide. Then by looking at these sections in succession he can form an idea of the solid structure of



Analogous view of a "cuboid" of four dimensions appearing as a figure of three dimensions.

the germ cell. Mathematicians have rules by which such sections of a solid figure may be constructed by means of equations. They start with an equation which represents a solid body, for example, $x^2 + y^2 + z^2 = 9$ representing a sphere, and they perform certain operations by which they get a series of resulting equations that represent the successive sections of the solid body. It remains, then, merely to draw pictures of the sections from the data afforded by the resulting equations. By looking at all these pictures, a person may get a fair idea of the shape of the original solid. In the case of a sphere the sections are circles

of varying size. As we have already stated, an equation having four variable numbers, should by analogy represent a figure in space of four dimensions. Suppose we have such an equation, as $x^2 + y^2 + z^2 + w^2 = 20$. We can apply the same rules and perform the same operations to get sections of the figure represented by this equation. Curiously but consistently, these sections come out as solid figures. From the data afforded by the resulting equations, the mathematician can model these solid figures in clay and lay them in a row on the table before him. Just as the microscopist looks at the series of sections on his slide to get an idea of the solid structure of the germ cell, so the mathematician can look at the series of clay models before him and possibly feel that he has some idea of the nature of the four-dimensional figure represented by the equation with which he started.

Thus we see how the fourth dimension may be studied by means of the equations which algebra furnishes. There is another bolder way. We have seen that we can hold three pencils so that each one of them will make a right angle with each of the others. Instead of saying that it is absurd to suppose that a fourth pencil can be held in a position so as to form right angles with each of the first three pencils, let us assume that it can be done. Without any further assumptions a complete geometry of four dimensions can be built up by pure reasoning. Many of its conclusions are no more obvious to the senses than is the fundamental assumption with which it starts. Still that is the only assumption; all else may be deduced from that one assumption and from the principles of our well-known plane and solid geometry.

An illustration of a special method in the study of space of four dimensions may serve to show how mathematicians reason about such things without being able actually to imagine them. We proceed by ascertaining the relations between two dimensions and three dimensions, and then establishing these relations by analogy between three dimensions and four dimensions. Suppose we have a glass cube resting on the table before us and we close one eye and look straight down upon it with the open eye. Its appearance will be as shown in the accompanying drawing. This drawing is really a plane figure, of two dimensions, and it might have been produced in the following manner; namely, by drawing one square inside of another and then drawing lines connecting the corresponding corners. All this could be done without any thought of three dimensions. The bees in the glass hive could draw such a figure as the one here on the paper before us. Nevertheless, on this figure many of the properties of the cube can be studied. By counting the four-sided figures (ABCD, EFGH, AEFB, BFGE, CGHD, DHEA), which we find to be six, we learn how many faces the cube has. By counting the corner points, which are eight, we learn how many corners the cube has. By counting the lines, which are twelve, we learn how many edges the cube has. Just as starting with the squares we are able to get a two dimensional figure, which, for the purposes of investigation, may be taken as representing the cube, may it not be possible that starting with cubes we can get a three-dimensional figure which shall represent the four-dimensional figure which we call the cuboid? Just as we drew a smaller square inside of a larger one, so we should think of a smaller cube inside of a larger cube, and just as we drew lines joining the corresponding corners in the case of the squares, so we should make planes joining corresponding edges in the case of the cubes. The figure so formed is somewhat imperfectly pictured in the accompanying drawing, and for the sake of clearness, let us suppose we have such a solid glass figure before us. In the case of the squares, to find from them how many square faces the cube has, we counted the big outer square, the small inner square and the four surrounding figures and got six as the result. So in the case of the cubes, to find from them how many cube faces the cuboid has, we count the big outer cube, the small inner cube and the six surrounding solid bodies and thus get eight as the result; this indicates that the cuboid has eight cube faces. A further study of this representative figure discovers that the cuboid has 24 plane square faces, 32 edges and 16 corner points. This shows how we can get a representation of a four-dimensional body, and on this representation we can study its properties. There are many considerations which we have not space to present which confirm the accuracy of the deductions that have just been stated.

What is the use of such generalities, abstractions and speculations? About the same as to know whether the earth goes around the sun or the sun goes around the earth. Space is as properly an object of scientific study as are planets or geological strata. Moreover, the study of these fundamental things in geometry throws light on the nature of our own mental equipment. We learn better what is the nature of reasoning processes and how knowledge is built up from simpler and more fundamental elements. Such speculations sometimes lead to very useful results.

If you hold 5 marbles in your hand and are told to

take away 8 of them, this suggestion seems as unthinkable as the suggestion of a fourth dimension. But when men chose to represent by —3 the result of subtracting 8 from 5, instead of simply saying it was impossible, then the foundation was laid for the enormously useful science of Algebra.

The assumption of a fourth dimension has not as yet led to any noteworthy useful results, but it is by no means impossible that the science of four-dimensional geometry may come to have useful applications. It has been suggested by Prof. Karl Pearson that an atom may be a place where ether is flowing into our space from a space of four dimensions. It can be shown mathematically that this would explain many of the phenomena of matter. At the present stage, the suggestion is regarded, even by its author, as merely fanciful, though it is not as fanciful as the proposition of the German spiritualists who regard the fourth dimension as the abode of their disembodied spirits.

SOME NEW WARSHIPS AND THEIR EQUIPMENT.

(Concluded from page 56.)

been entered upon seriously, and four battleships were laid down simultaneously in Baltic yards on June 16th. The "Sevastopol" and "Petropavlovsk" are building at the Baltic works and the "Poltava" and "Gangut" at the new Admiralty yard, the English firm of John Brown & Co. being in charge of the work. On a displacement of 23,000 tons they will carry twelve 12-inch guns, arranged as shown, as well as sixteen 4.7's and four torpedo tubes. The speed will be 24 knots and the horse-power 42,000, which is very high for battleships. Meanwhile four other battleships which were laid down in 1903—the "Imperator Pavel" and the "Andrei Pervozvanni" in the Baltic and the "Ioann Zlatoust" and "Evstafi" in the Black Sea—are still incomplete.

It is only four years since the first all-big-gun ship was laid down; but the following table will show how completely the idea has seized upon the naval powers. It shows the number of battleships of this type completed, under construction, or to be laid down this year:

TABLE SHOWING TOTAL GUN POWER OF "DREADNOUGHTS."

	Great Britain.	Germany.	United States.	Austria.	Italy.	Russia.	Brazil.	Spain.	China.	Japan.	Chili.	Argentina.
Eight 14-in.					3	0						
Ten 13.5-in.	4				3							
Twelve 12-in.	0	6	2		4	3	0			2		
Twelve 11-in.		7			6							
Ten 12-in.	8		4	4						2	2	
Ten 11-in.		0										
Eight 12-in.	4	2						3	3			
Total in ships of this type	152	156	80	40	48	48	36	24	24	24	20	20

We also present a table which analyzes these vessels according to their main armament. It will be seen that, but for her four ships of this year's programme, British designs would "put up a poor show."

	Battleships.	Cruisers.
Great Britain.....	152	4
Germany.....	156	3
United States.....	80	0
Austria.....	40	0
Italy.....	48	0
Russia.....	48	0
Brazil.....	36	0
Spain.....	24	0
China.....	24	0
Japan.....	24	0
Chili.....	20	0
Argentina.....	20	0
	57	7

* Besides four "provisional" ships. † Eight 12-inch. ‡ 15,000 tons. Query "Dreadnought" type.

OPENING OF THE DOWN-TOWN HUDSON TUNNELS.

(Concluded from page 57.)

ing the eye, must afford a contrast generally garish and out of harmony with the otherwise excellent and subdued decoration.

This is doubtless a considerable source of income, difficult to forego in these commercial days; but considering the dignity and lack of ostentation with which the Hudson Companies have carried out both delicate negotiations and difficult engineering feats, considering also the immense profits likely to accrue from their undertakings, one might have hoped that they would omit this rather cheapening feature.

Stairways lead down from the concourse to the five platforms below, at each of which in rotation, separ-

ated by only 1½ minutes during "rush" hours, trains arrive by the southern and depart by the northern tube, there being no switching, and everything tending to the most rapid handling of traffic. Each train discharges its passengers upon the platform on one side of it and receives its new load from the platform at the other side, an arrangement which entirely separates incoming from outgoing passengers.

Again, below the rail level are extensive baggage and store rooms, and a subsidiary power station, making the Hudson Terminal Building a veritable city in itself, with clubs at the top, multitudinous business offices in between, a post office, telegraph office, and numerous shops below, and a railway station and power station in the basement, all inclosed within four walls.

THE SCIENTIFIC WORK OF THE LATE PROF. SIMON NEWCOMB.

Prof. Simon Newcomb died on July 11th in Washington at the age of 74. His death has removed not only the most distinguished astronomer that America ever produced, but a man who is honored the world over for his monumental scientific achievements.

All Newcomb's work followed up with rare perseverance has constantly tended to this ideal end: First, to arrive at a more exact knowledge of the magnitudes serving as points of reference and then to establish the theory not only of all the planets but also of their satellites on a system of constants as precise as modern observations permit.

Shortly after he graduated from the Lawrence Scientific School at Cambridge, he began the first important problem with which his name is associated, namely, the motions and orbits of the asteroids which revolve about the sun between Mars and Jupiter. It was once thought that perhaps these numerous bodies might be fragments of a large planet which had been shattered by explosion or collision. Were this true, the orbits would pass through the point at which the explosion occurred. As more and more asteroids were discovered, the coincidences of orbits became less marked. Still the theory was adhered to, because it was thought possible that the attraction of the larger planets might have caused perturbations. In order to decide for or against the theory, it was necessary to discover general formulae by which the positions of the orbits could be determined at any time in the past, so that it could be ascertained whether or not the orbits ever did pass through a common point of explosion, in which case it would be possible to give an approximate date for the catastrophe. As a result of Newcomb's painstaking investigation, he concluded that the orbits had never passed through any point of common intersection. Later investigations based on Newcomb's work have shown that the hypothetical cataclysm never occurred, and that the asteroids probably always existed as minor planets. The paper which Newcomb read on the subject at the Springfield meeting of the American Association for the Advancement of Science in 1859 was the first that brought him into prominence—a young man of but twenty-four.

When Newcomb commenced his work at the Naval Observatory in 1861, the problems of the moon's motion had attracted astronomical attention. The most perfect lunar tables at the time were those of Hansen. Hansen had only a single assistant and could not, therefore, make the great number of observations required in the case of a body moving so rapidly as the moon. For a year or two Newcomb's observations showed that the moon seemed to be falling a little behind her predicted motion. This soon ceased, however, and she gradually forged ahead in a most remarkable way. In five or six years it was apparent that this acceleration was becoming permanent. Astronomers were puzzled to account for the phenomenon. For half a century the moon had apparently been running ahead and had then relaxed her speed so far as to fall behind again. Hansen had suggested that the planet Venus might be responsible for these inequalities. He showed that for 130 years the moon would thus be made to run ahead and for 130 years to fall behind. For 100 years the moon seemed to have followed Hansen's theory. Yet Newcomb found that the moon was deviating. To ascertain whether or not Hansen's tables represented the motion of the moon perfectly since 1750, as astronomers supposed, Newcomb undertook an examination of the occultations of the moon with bright stars. It was not until the telescope had been introduced and used for finding the altitude of a heavenly body and not until the pendulum had been invented by Huyghens that the time of an occultation could be fixed with the required exactness—a task first systematically performed by French astronomers of the eighteenth century. Newcomb suspected that some accurate observations had been made before their time, which he might use in checking up Hansen's tables. He found that a few such observations had actually been made between 1660 and 1700 and discovered to his surprise that Hansen's tables were evidently much in error. But to de-

termine the cause of the errors was impossible without more observations. Newcomb planned a thorough search of the old records of Europe. On the occasion of the solar eclipse of 1870, he was sent abroad to observe the phenomenon for the Naval Observatory. He seized the opportunity to go to Paris and consult the old records of the observatory there. After a search he found that the very observations he wanted had been made in great number by the Paris astronomers, both at the observatory and at other points in the city. Three or four years were spent in making calculations on the basis of these Parisian researches, when it was found that seventy-five years were added in a single step to the period during which the history of the moon's motions could be written. Before Newcomb's work this history was supposed to commence with the observations of Bradley at Greenwich, about 1750. Now it was extended back to 1665, and with a less degree of accuracy farther still. Hansen's tables were found to deviate from the truth in 1675 and subsequent years to a surprising extent. But the cause of the deviation is not entirely unfolded even now.

In 1877 Newcomb took charge of the Naval Almanac Office. He thoroughly reorganized the office and placed it upon a more scientific footing. He mapped out a programme of work which involved a discussion of all the observations of value on the positions of the sun, moon, and planets, and incidentally on the bright fixed stars, made at the leading observatories of the world since 1750—a programme which involved a repetition, in the space of ten or fifteen years, of an important part of the world's work in astronomy for more than a century past. It was impossible to carry out this plan in all its completeness, so that Newcomb was obliged to confine himself to a correction of the reductions already made and published. For all that, the task was one which, in magnitude, probably exceeded any ever before attempted by any astronomer. The number of meridians observed on the sun, Mercury, Venus, and Mars alone numbered 62,030. Still other branches of the Nautical Almanac Office work involved the computation of formulae for the perturbation of the various planets by one another.

Important among the troublesome problems with which Newcomb had to deal while in charge of the Nautical Almanac was that of universal time. There was a day when every railroad had its own meridians by the time of which its trains were run, which had to be changed here and there in the case of the great trunk lines and which seldom agreed with the local time of a place. The passenger was constantly liable to miss a train, a connection, or an engagement by the doubt and confusion thus arising. All this was remedied in 1883 by the adoption of our present system of standard times of four different meridians, the introduction of which was one of the great reforms of our generation with which Newcomb's name is associated. When the change was made, Newcomb was in favor of using Washington time as a standard, instead of Greenwich. But those who were pressing the measure thought it advisable to have a system for the whole world, and for this purpose the meridian of Greenwich was the natural one.

By 1894 Newcomb had succeeded in bringing so much of his work as pertained to the reduction of the observations and determination of the elements of the planets to a conclusion. So far as the general planets were concerned, it remained only to construct the necessary tables which, however, involved several years' work. Before Newcomb's time, the confusion which pervaded the whole system of exact astronomy, arising from the disclosures of the fundamental data employed by the astronomers of the various countries and various institutions in their work, was such that it was rather exceptional to base any astronomical result on entirely homogeneous and consistent data. To remedy this state of things and to start the exact astronomy of the twentieth century on one basis for the whole world, was one of the plans which Newcomb had mapped out for himself when he took charge of the Nautical Almanac Office. Dr. N. W. Downing, superintendent of the British Nautical Almanac, was animated by the same motive. He had especially in view the avoidance of duplicate work which arose from the same computations being made in different countries for the same result. The field of astronomy is so vast and the quantity of work required to be done so far beyond the power of any one nation that a combination to avoid all such waste was extremely desirable. When Newcomb published his preliminary results in 1895, Downing took the initiative in putting the idea into effect by proposing an international conference of the directors of the four leading ephemerides to agree upon a uniform system of data for all computations pertaining to the fixed stars. This conference was held in Paris in May, 1896.

In 1902, when the Carnegie Institution was organized, it made a grant to supply Newcomb with computing assistants and other facilities necessary for the completion of his study of the moon's motions.

THE DISINFECTION OF SCHOOL BOOKS.

BY JACQUES BOYER.

Although our age prides itself on obeying all the laws of hygiene, many of the administrative regulations which are actually in force directly violate these laws. In the primary schools of France, the books pass annually from one pupil to another, without any attempt being made to prevent the propagation of contagious diseases in this way. Now, despite the good wishes and efforts of the teachers, the personal cleanliness of the pupil is not always above suspicion. The children often come to school with soiled garments, dirty faces, and greasy hands. Even if the morning ablutions have not been entirely neglected, the little ones may carry with them the germs of tuberculosis, scarlet fever, whooping cough, smallpox, or other diseases. The teachers' injunction not to wet the fingers in turning the leaves of books is universally disregarded.

At Montreuil, near Paris, a method of disinfecting school-books, which should almost entirely prevent the dissemination of disease, has recently been introduced; but before we describe this system, let us cite a few typical instances of the propagation of diseases by books and papers.

The following case was reported to the Academy of Medicine by Dr. Josias. A lady residing with her daughter in a Breton village, which was entirely free from scarlet fever, received a letter from the child's governess, who was then traveling in Germany. The governess wrote that she had had an attack of scarlet fever, but was now convalescent and had just entered the period of desquamation. A few days later, the mother and daughter contracted scarlet fever. The mother died, and the daughter barely escaped with her life.

Brouardel records the propagation of an epidemic of tuberculosis among the clerks of the archives of Kharkof (Russia). One of the clerks, who was in the second stage of tuberculosis, was in the habit of wetting his finger in his mouth in turning over the pages of the registers which he had to consult. French army surgeons have found disease germs in the records of numerous hospitals; and Dr. Knop, of New York, in his work on the "Tuberculous Infection of Books," cites the case of twenty clerks of the health department of Lansing, Mich., who became victims of tuberculosis as a result of handling books infected by one

of their colleagues. It has been shown by numerous experiments that cultures of microbes spread on paper show a resistance which varies greatly with the species of microbes. The cholera vibrio becomes inert in 48 hours, the germ of diphtheria in 28 days, the bacillus of Eberth in 40 days, and Koch's bacillus in 130 days.

Various methods of disinfecting books have been invented. The most effective method would be the total

left to the reader's imagination. The original process of Berlioz and Championnière does not seem much better. This process consists in subjecting the objects to the vapor of formic and ethylic aldehydes in an oven heated to about 200 deg. F. This treatment, continued for two hours, completely destroys the most virulent germs (tuberculosis, diphtheria, coli bacillus, etc.) placed on the edges, or even in the center of the volumes. For example, a large volume of 1,300 pages

was selected for experiment. One of the middle pages was saturated with pus, and another was soiled with fecal matter. A portion of each of these pages was torn off for use as a control. The volume was then placed in the disinfecting oven, and heated for two hours and fifteen minutes to about 180 deg. F. Experiments in producing cultures with the soiled parts gave entirely negative results. Unfortunately, the treatment slightly injured both paper and binding. Marsoulan has recently improved this method by the invention of the simple apparatus which is now in use at Montreuil, in the workshops where diseased persons and cripples are employed. In the improved process, the books first go through the beater. This machine is a long box connected at one end to an ordinary stove, and provided at the other end with a door through which open racks containing the books are introduced. Inside the box wooden rods are caused to rise and fall, alternately,

by cams placed on a cylinder which is turned by a crank. A ventilating fan and a sliding drawer complete this apparatus, which is mounted on trestles. When the crank is turned, the rods strike the covers of the books and dislodge the dust. The heavy dust falls into the drawer upon a mass of sawdust, saturated with a powerful disinfectant, while the lighter dust, carried off by the air current, is consumed in the stove. After this treatment, the books are suspended singly by pincers from a series of open metal racks, the covers of the book being bent back. Thus the pages are freely separated, and give easy access to the antiseptic vapor. These racks are mounted on rails, on which they are run into the disinfecting oven. Each of the three ovens employed at Montreuil accommodates two racks of books. The ovens are sheet-iron boxes, hermetically closed. Two sides of the box can be raised by cranks to admit the book racks. In the center of the oven is a vessel filled with a solution of formic aldehyde, into which

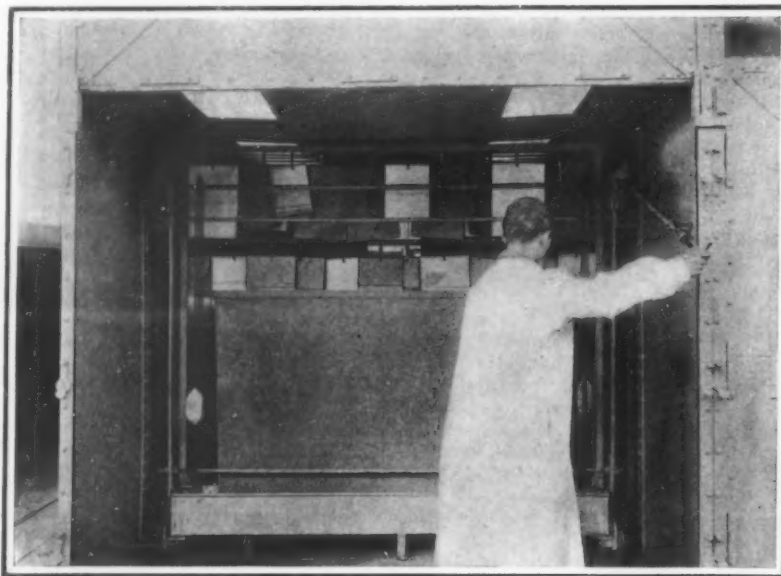


Fig. 4.—Agitating the felt saturated with formic aldehyde.

destruction of the books, but this is too radical to be employed except in rare emergencies. In some English and Scotch cities, the public libraries receive daily, from the health bureaus, the names and addresses of all cases of infectious disease. If it is found that any books have circulated in infected houses, these books are disinfected or, in some cases, destroyed. This system is used in Bradford and Birkhead. In London, where the density of population would greatly complicate the problem, no books are loaned.

In France, Dr. Lop proposed, several years ago, to disinfect the books of the primary schools every summer; also to disinfect the books, notebooks, and clothes of every pupil attacked by a contagious disease. But how can a book be disinfected without damaging it? Krauz recommends exposure to high-pressure steam for 40 minutes. The condition of the binding and the pages after such treatment may be

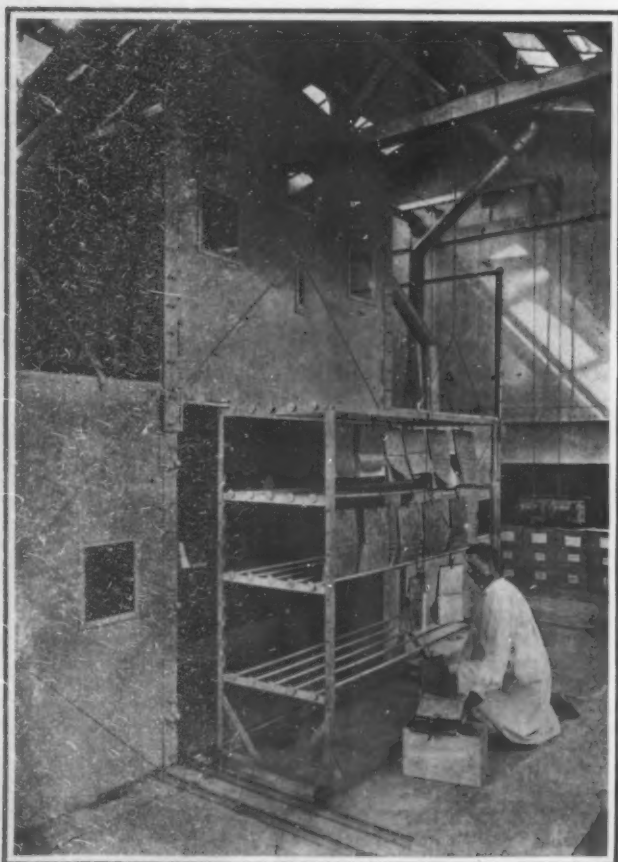


Fig. 1.—Sliding the rack of books into the disinfecting oven.

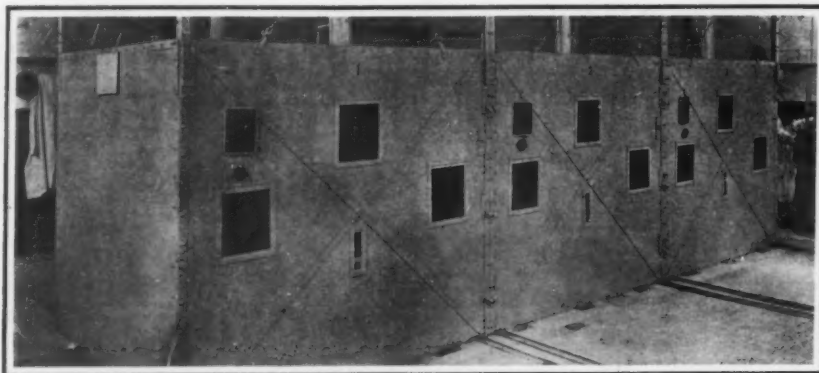


Fig. 2.—The disinfecting ovens.

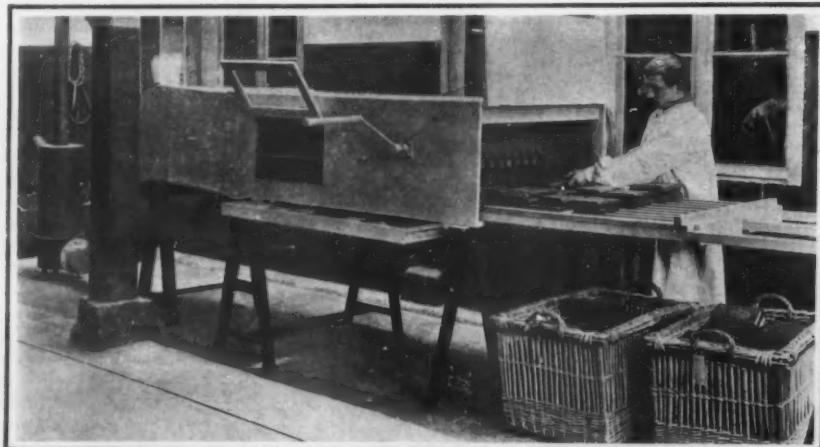


Fig. 3.—The beating machine, which frees the books from dust.

dips a strip of felt, which can be moved up and down from the outside of the oven. The ovens are heated, by steam pipes placed below them, to 122 deg. F. The irritating vapor of formic aldehyde makes its escape through a pipe at the top of each oven. The operation of disinfection is simple. The vessel is filled with formic aldehyde, and the racks laden with books are pushed into the ovens, which are then closed and heated to the required temperature for a few hours. After the heating is stopped, the volumes are allowed to remain in the ovens until the next day, when they are found to be entirely aseptic. This improved process of disinfection does not injure either paper or cardboard. It is very efficacious, as has been proved by the experiments of Dr. Miquel, and it is also very cheap, costing only about one-half cent per volume. The Municipal Council will shortly be asked to establish new disinfecting plants at various points around Paris, in order to extend the system to all the school libraries of the Department of the Seine. Several foreign cities are about to follow this example.

AN AMERICAN FARMOBILE.

BY FRANK C. PERKINS.

The accompanying illustration shows an American gasoline plow tractor in service. The machine is operated with a cable, but the plow is not drawn along wholly by traction. Two cable drums are provided, each having five grooves to fit the cable. The cable is coiled around the drums five times and then

road or the hauling of wagons or machinery across the farm.

A New Kind of Illuminating Gas.

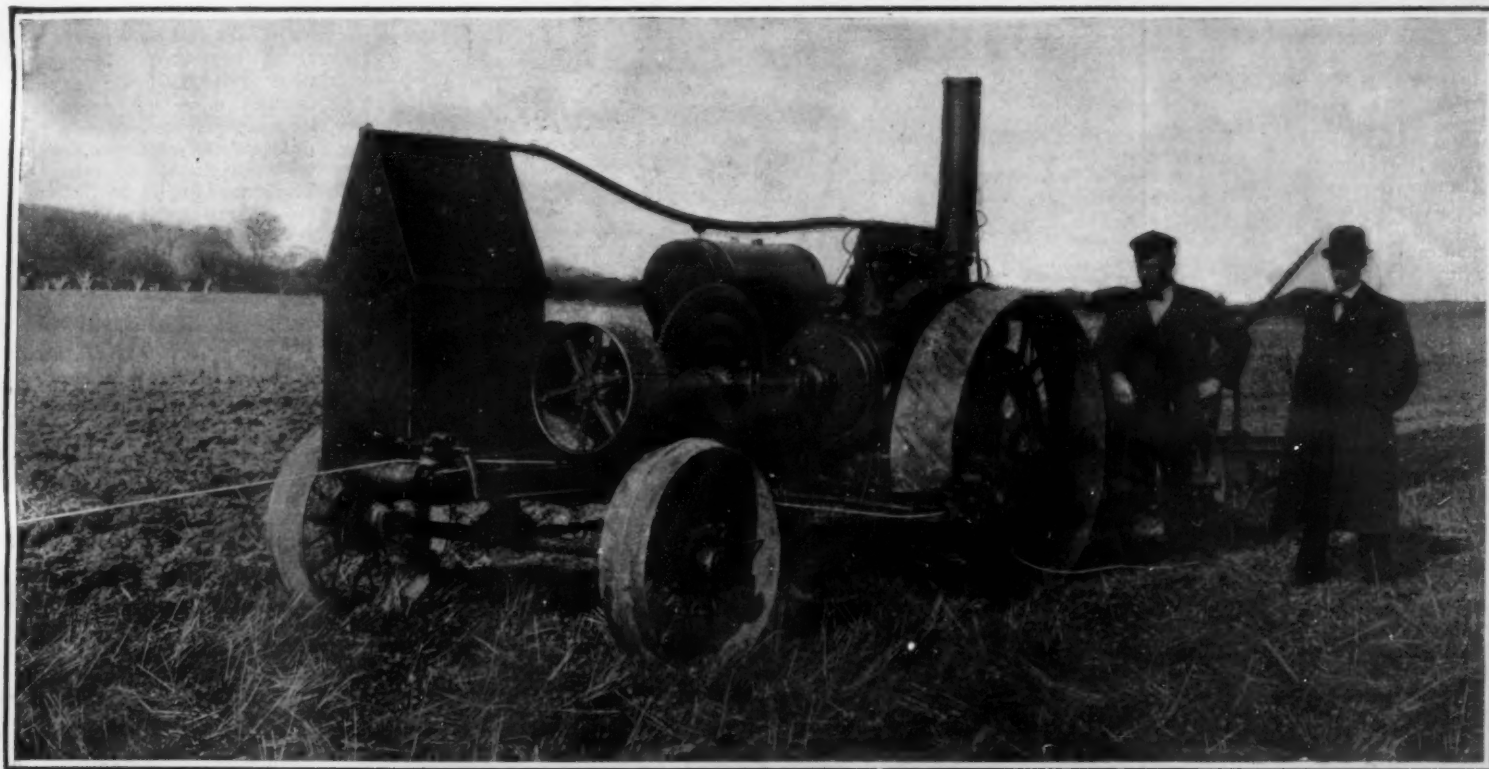
What is known as the De Laitte system of lighting houses with gas has attracted not a little attention in Europe. Private electric light, coal, or kerosene gas plants, because of their very large initial cost, cannot always be installed. Since gasoline has come into fairly common use and is obtainable almost everywhere, a French inventor, M. Benoit de Laitte, has devised a method of generating gas from gasoline. When gasoline vapor is passed into pipes having a temperature lower than that at which the evaporation is accomplished, some of the gasoline will recondense into liquid form. Because the supply piping is underground and exposed to low temperature in winter, not a little trouble is thus caused. De Laitte has devised a carburetor which is intended completely to vaporize gasoline in very cold weather without the application of heat. In it the temperature of evaporation falls as low as -17 deg. Fahr., which is far below the lowest winter temperature in most civilized countries. For this reason condensation is practically impossible.

It has been found that air will absorb variable proportions of gasoline, depending upon the humidity of the atmosphere. To overcome this objection, De Laitte extracts all the moisture from the air, which is carefully kept from contact with water, and thus the air on carburetion is perfectly dry. Hence a uniform gas

buildings, railway stations, etc. About twenty or thirty plants are installed in India.

The Current Supplement.

The current SUPPLEMENT, No. 1751, opens with an interesting article by the English correspondent of the SCIENTIFIC AMERICAN on a new type of transporter for handling meat at Buenos Aires. The length of life of a motor boat and engine is so dependent upon proper care, that it will pay every owner of such a craft to understand thoroughly the vital points to be remembered, and to see to it personally that the boat and power plant are kept in good condition. Mr. Harold Whiting Slauson gives the necessary information in an article entitled "The Care and Operation of a Small Motor Boat." An automatic device for securing the profile of the ground, such as is needed for railroad work, is described by the Paris correspondent of the SCIENTIFIC AMERICAN. A graphic comparison of steam and gas engines as power producers is presented. James Ferguson's famous mechanical paradox is described—a device which consisted of three geared wheels that performed rather remarkable revolutions because the number of teeth in the three wheels were not the same. T. C. Bridges writes on Martyrs to Science. The future of the earth is discussed in an article by Abbé Moreux, in which he points out that our earth may be changing its shape. S. Leonard Bastin writes interestingly on the mimicry of plants. G. Devaulay contributes a most instructive article on



AN AMERICAN FARMOBILE.

projects from the side of the machine. The harder the pull on the machine the tighter the grip of the cable on the drums. Still, there is no friction because the cable fits the groove, and because the traction wheels and the cable are geared together, so that all the tractive effort and the balance of the load fall on the cable.

When a soft spot is encountered or sand interferes the wheels will slip a little, and the cable will take up the load. In other words, the traction wheel is geared about 10 per cent faster than the cable drums, thus causing the traction wheels always to slip a little on the ground on a hard pull. In a field demonstration the cable clutch was thrown out and the machine started, but it could not move from its own tracks. It stood and dug a hole 15 or 18 inches deep. The cable was then thrown in by the clutch and the tractor moved on. The machine is capable of pulling ten plows at a weight of about 8,500 pounds.

When the tractor is run to the end of the field the cable is uncoupled at the front of the machine and the rear. The machine and plows are then turned around, and the front end of the machine is coupled to the cable.

In using the machine it is necessary to stake off a strip of land about 200 to 300 feet wide and to string a cross cable at both ends of the field with a single snatch block running upon it.

It is stated that in some instances as much as a mile of cable is used. By shifting the large bevel gear the pinion is disengaged, so that the machine may be used for threshing or general farm work.

The tractor has three speeds, $1\frac{1}{2}$, $2\frac{1}{2}$, and $3\frac{1}{2}$ miles per hour. The $3\frac{1}{2}$ -mile speed is for traction on the

is produced without the possibility of variation.

The principle of the De Laitte process consists in the fact that a measured quantity of gasoline is converted into vapor by a measured quantity of air passed in a brisk current over a large surface of gasoline. The particular part of the apparatus in which this is accomplished is the carburetor. The current of air is produced by means of a drum, which induces a certain fixed quantity of air for each revolution, and this movement is obtained by a gear in such a manner that for every cubic foot of air taken up, a fixed amount of gasoline is induced into the carburetor. By this means a gas of unvarying quality is obtained, and perfect evaporation effected.

The carburetion takes place in a flat metal tube of considerable width and small depth. The gasoline flows downward, covering a large surface, over which the rapid current of air is conducted. The evaporation thus caused is so vigorous, that absolutely no residue is left when good gasoline is employed, even at a temperature many degrees below the freezing point. The proper gas is collected in a small gasometer, which serves to regulate the pressure, and which acts on the driving power of the drum in such a way that when no gas is required, the apparatus is stopped.

The motive power necessary to drive the apparatus is exceedingly small—a weight, water power, electricity, hot air, or a gas motor being employed. The gas is burned with incandescent mantles, but in consequence of the exceedingly high temperature and combustion, the illuminating power is considerably increased.

Between thirty and forty towns are lighted on this plan in Europe. In England there are about six thousand installations, which include hundreds of public

the precision of astronomical observation. An apparatus for electrolytic refining of precious metals is described by H. La Croix. Dr. Max Dieckmann presents a partial solution of the problem of electrical vision at a distance. We have had occasion recently to mention in these columns a new musical instrument called the "choralcello," which depended upon electrically-vibrated musical springs for the production of musical sounds. The particular apparatus employed is described in the current SUPPLEMENT.

The wheels of automobiles are usually inclined to the vertical, because the spindles on which they turn are slightly inclined to the rest of the axle. This practice of inclining the spindle originated in horse-drawn vehicles, in which the wheels are dished, that is to say, the spokes are arranged, not in a plane, but in a conical surface, with the apex inward, for the purpose of giving greater resistance to lateral shocks. With the dished wheel the inclination of the spindles is necessary, for the wheels of horse-drawn vehicles are high and their spokes long, and it is desirable that the spoke which for the moment is supporting the weight should be in a vertical position.

It may be doubted whether this argument applies to the small, compact, and stout wheels of automobiles. The constructors of the first automobiles regretted that the chains apparently made it impossible to incline the driving wheels. It was subsequently discovered that the chains did not form an obstacle, and hence the wheels are now inclined. It is questionable, however, whether this construction does not have the effect of giving the wheel a tendency to run in a circle, and of increasing the friction against the ground.

THE FLIGHT OF THE CURTISS AEROPLANE FOR THE SCIENTIFIC AMERICAN TROPHY.

After repeating at dusk on July 5th his performance first accomplished on the 26th ultimo of circling two-thirds of the way around Morris Park race track, Glenn H. Curtiss took the Aeronautic Society's new biplane to Mineola, L. I., in order to practise with it upon a wide open expanse, and if possible set up some records. At dusk on July 13th he made three flights—two short ones of 200 to 300 yards, and one long one of 1½ miles and nearly 3 minutes' duration. In the latter the aeroplane disappeared from view and weirdly reappeared from out the fast-gathering darkness. The following morning an excellent 5-minute flight was accomplished, and 24 hours later this performance was almost repeated when a piston cracked in the motor and the flight was necessarily terminated. This flight was made in a dense fog between 6 and 7 A. M.

After new and stronger pistons had been fitted, Mr. Curtiss made two more excellent flights early last Friday morning. The first of these started at 5:30 A. M. and lasted 7 minutes and 20 seconds; while the second one, which was made at about 7:20 A. M., lasted 20 minutes and 40 seconds, and consisted of some twelve circuits of an oval course of from a mile to a mile and a half in length. The height varied from 5 or 6 to 30 or 40 feet. There was a light wind of 6 or 8 miles an hour, and when the machine flew against it, it rose, while when it turned to go with the wind, it dropped considerably. During this flight, the aviator described two figure eights with great ease.

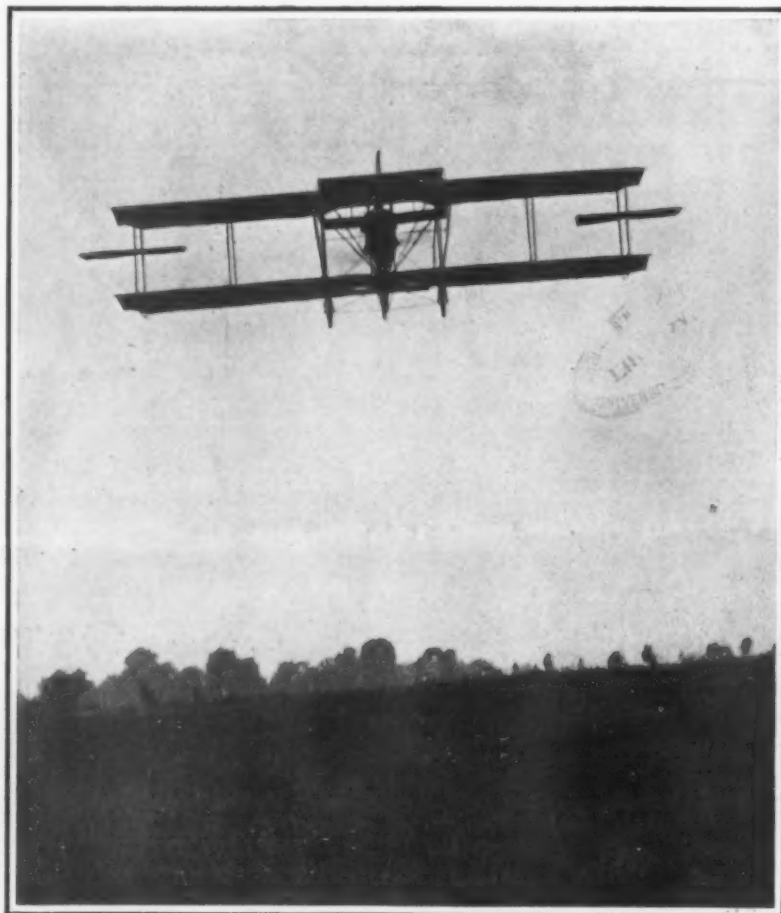
After the above preliminary practice, Mr. Curtiss decided that he would attempt to set up a record for the SCIENTIFIC AMERICAN Trophy early last Saturday morning. Mr. Charles M. Manly, of the Contest Committee of the Aero Club of America, was present and timed the flights. As the weather was clear and the air calm, the aeroplane was brought out of its tent about 5:09 A. M., shortly after sunrise. A triangular course measuring 1.3 miles had been staked out on the vast plain near the village. Mr. Curtiss decided that he would make one circuit of this course in a second attempt to win the President's prize of the Aero Club of America. These four prizes of \$250 each were offered by Mr. C. F. Bishop for the first four machines to fly one kilometer. Mr. Curtiss covered the required distance in his flight at Morris Park on June 26th, but as this flight was made just after sunset, he decided to make another about which there could be no question. The rules state that all flights for prizes must take place between sunrise and sunset.

About 5:15 A. M. Mr. Curtiss climbed upon the aviator's seat of his small biplane, and his assistant started the motor by turning the propeller. The machine moved forward quickly as soon as it was released, and after traversing about 200 feet of the rough marsh land, it rose gracefully and flew straight for the first turn. This was taken without any difficulty, the machine inclining but slightly inward. It then traveled eastward beside a row of trees and was brought about in a wide sweep at the apex of the triangle. As it approached the spectators on the last leg of the course it seemed to be traveling very slowly, yet that this was not so was shown by the time of the circuit, which was 2 minutes and 30 seconds, corresponding to an average speed of 31.2 miles an hour. After alighting, Mr. Curtiss stated that he had throttled down his motor so as to fly as slowly as possible.

The flight for the SCIENTIFIC AMERICAN Trophy was started at 5:23:16 A. M. The minimum required distance—25 kilometers, or 15½ miles—made necessary 12 circuits of the triangular course. These were completed successfully in about 33½ minutes, but the machine continued flying for seven more rounds. It finally alighted at 6:15:46, just 52½ minutes after it crossed the starting line. Mr. Curtiss would have continued longer had it not been for a rather brisk wind which sprang up while he was making the last three or four rounds. This made the machine more difficult to balance when flying across the wind. Nevertheless, Mr. Curtiss seemed to have no great difficulty in managing it, and he could doubtless have continued a quarter of an hour longer if he had had sufficient fuel

in the tank. The average speed of the machine was about 28¼ miles an hour, if figured upon the actual distance between the stakes of the course, but as the machine did not fly very close to the stakes in making the turns, it is probable that this average speed was considerably over 30 miles an hour. The actual measured distance flown was 24.7 miles, while in reality the machine probably covered 30 miles in the 52½ minutes it was in flight.

The impression received by the several hundred spectators who witnessed the flight was the slow speed at which the machine seemed to travel and the perfect ease with which it moved forward through the air. At times it was sent to a height of 40 or 50 feet, and then again it would drop to within 5 or 6 feet of the ground. These ascents and descents were always gradual and were generally the result of the aviator's guiding. In making a turn, however, the machine invariably loses speed and drops perceptibly. Sometimes, also, it would dip inward too much and the aviator could be seen leaning outward in order to set the balancing planes and bring the machine to a level keel. As it is only about half the weight of the Wright machine, the Curtiss aeroplane does not feel the effects of centrifugal force nearly so much in making a turn, and consequently it can negotiate a rather



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GLENN H. CURTISS FLYING FOR THE SCIENTIFIC AMERICAN TROPHY.

In the Aeronautic Society's new biplane Mr. Curtiss flew between 25 and 30 miles in 52½ minutes near Mineola, L. I., last Saturday.

sharp curve with but very slight inclination inward to keep it from skidding. The control of the machine by means of a single vertical wheel in front of the aviator (which is pulled or pushed for going up and down and turned for steering sideways) is exceedingly simple and should make it easy for any one used to an automobile and a bicycle to learn to operate it with but little instruction.

While Mr. Curtiss's record of 52 minutes and 30 seconds will no doubt be increased before the end of the year, it is by no means to be despised for a beginning. The only record that approaches it in this country was that made by Orville Wright at Fort Myer, when he remained aloft 1 hour, 14 minutes and 24 seconds last September. This flight of Mr. Curtiss does not entitle him to the trophy immediately. If any other aviator succeeds in outdoing Mr. Curtiss's performance, then the trophy goes to him. Who wins the trophy for 1909 can be determined only at the end of the year, for according to the rules the trophy will be won by the aviator who makes the best performance during the year. If, during the present year, any other aviator surpasses Mr. Curtiss's record made last Saturday, it is probable that Mr. Curtiss will make another attempt to beat the new record. Should he put up the best record for 1909 he will have to win the cup for but one more year to become its permanent holder.

It is especially gratifying to the publishers of the SCIENTIFIC AMERICAN that the handsome trophy which they gave to encourage aviation in America has resulted in the production of two such excellent machines as the "June Bug" of the Aerial Experiment Association (which won the trophy last year) and the new Curtiss machine, which is now the property of the Aeronautic Society. With this excellent beginning there is scarcely any doubt that the trophy will be the means of stimulating other inventors to devise and perfect their heavier-than-air flying machines, and probably another year will witness an aeroplane race for the trophy similar to the great automobile races held in recent years.

A New Cross-Country Monoplane Record.

M. Louis Bleriot, who is by all odds the most experienced aeroplanist in France, has lately made some excellent new records with his two machines Nos. 11 and 12, both of which have been illustrated in our columns. On June 25th, at Issy-les-Moulineaux, M. Bleriot flew with his No. 12 monoplane for 15½ minutes, making 11 complete circuits of the parade ground despite the fact that there was a rather strong wind blowing. On the 26th ultimo he flew for 36 minutes and 55 3/5 seconds, and would have made a longer flight had it not been for the engine missing fire because of over-lubrication. The motor used in this machine is a 25 H.P. three-cylinder air-cooled Anzani engine, which has given excellent results.

After the above-mentioned flights M. Bleriot took this machine to Douai, where he made a number of excellent flights for prizes. The latest and most sensational flight that this daring aviator has thus far accomplished was made on July 14th with his No. 11 monoplane. Starting from Etampes, he flew 20 miles across country to Toury, where he alighted and made a stop of 11 minutes. Re-ascending, he flew 13 miles farther to Chevilly, where the flight terminated. The total duration of the two flights was 45 minutes, which means that the 33 miles was covered at an average speed of 40 miles an hour. The fact that this machine, with a weight of 700 pounds, travels at a 40-mile clip with but a 25-horse-power motor, speaks well for the efficiency of the single monoplane surface. Both of Bleriot's monoplanes have flown in winds of from 12 to 15 miles an hour successfully, and the new cross-country record which he has just achieved places this type of machine in the lead as far as practical point-to-point flying is concerned.

Changes in the Patent Office Staff.

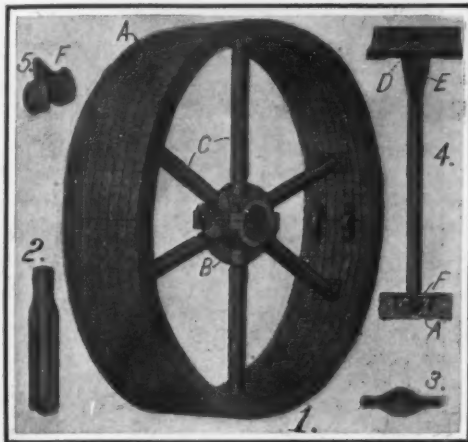
The President has appointed C. C. Billings first assistant commissioner of patents, and F. A. Tennant as assistant commissioner of patents. The position of first assistant commissioner of patents was created by the last Congress, as was that of examiner of classification, which is to be filled by E. D. Sewall. Mr. Billings was formerly assistant commissioner. Mr. R. F. Whitehead, who formerly occupied the position of law clerk, has been made law examiner. Among other promotions are those of J. H. Lightfoot, J. F. McNab, and L. D. Underwood to principal examiners; H. Barker, R. E. Marine, J. H. Carnes, E. Collins, Jr., and F. W. Swanton to first assistant examiners; T. L. Mead, Jr., and W. I. Wayman to second assistant examiners, and H. E. Smith to third assistant examiner. For the first time in the history of the Patent Office, reductions in rank were also made. Two principal examiners have been made assistant examiners.

Defects in insulators may be due, not to improper constituent parts, but to annealing. They may be discovered by means of polarized light. Each insulator is mounted, for purpose of test, so that when rotated about its pin axis the same thickness of glass skirt is between the polarizer and analyzer, which has previously been arranged so as to allow no light to pass. Stresses in the insulator are shown by varying intensity of light and by color changes, being due to improper annealing. Under service conditions the insulators become heated owing to conductive leakage, and are destroyed if the annealing has not been carefully done.



A NEW TYPE OF SPLIT PULLEY.

The pulley illustrated in the accompanying engraving has been designed with a view to combining the advantages of the wooden type with those of the steel



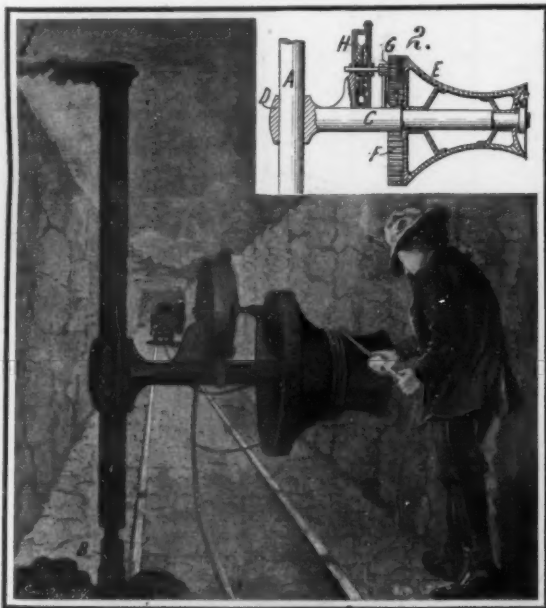
A NEW TYPE OF SPLIT PULLEY.

type of pulley. In the improved construction a wooden rim *A* is used with a metal hub *B* and spokes *C*. The spokes or arms are attached to the hub and rim without rivets or screw-threaded parts. They are made of seamless steel tubing pressed into a ribbed form, as shown in Figs. 2 and 3, so as to increase their rigidity. The hub, which is preferably of malleable iron, is formed with bosses, each of which is provided with a double-tapered orifice. The arms are driven into the orifices in the bosses, and by means of a swage their inner ends are flared out so as to fit the orifice and form a flange, as indicated at *D* in Fig. 4. The spoke is also formed with a flange *E*, which fits against the outer surface of the boss. Thus the arm is held against radial movement in the hub. The opposite end of each arm is flattened to enter a saddle *F* (Fig. 5) which is fitted into the wooden rim of the pulleys. The arm is secured in the saddle by means of a pair of transverse pins, which pass therethrough and enter the wooden rim. It is to be understood that the hub and spokes are first completed, and then the rim is built up and the saddle is fitted into the rim during its construction. The saddles are also made fast to the rim by means of screws. This pulley, it will be observed, combines the strength of the steel pulley at the hub with the lightness and friction surface or grip of a wooden pulley. The construction is very strong, and not liable to break apart in use.

A patent on this improved pulley has been secured by Messrs. R. H. Noble, T. C. Hook, and C. S. Hook of 79 Victoria Street, Toronto, Ontario, Canada.

PORTABLE WINCH.

The transfer of heavy material along the low, narrow drifts of a mine may be greatly facilitated by the use of a winch, such as illustrated in the accompany-

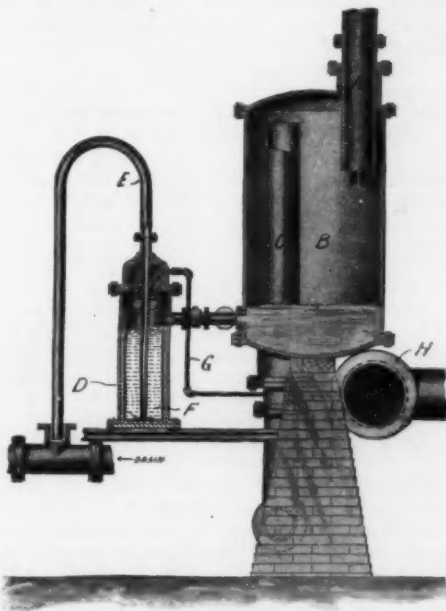


PORTABLE WINCH FOR USE IN MINES.

ing engraving. This winch is arranged to be attached securely upon the walls of the passage, but in such a manner that it may readily be removed and set up at any other point, as the transfer of material may require. A post, *A*, is provided which is adapted to be used in connection with an adjustable extension piece, *B*, of suitable length to secure the post in upright position between the floor and roof. Extension pieces of different length are furnished to provide for passageways of different height. An arm, *C*, is fastened by means of a clamp, *D*, to the post *A* at any convenient height thereon. A windlass drum *F* is mounted in turn on the arm *C*, being held in place by a collar secured to the end of the arm. The inner end of the drum is provided with an internal gear, *F*, meshing with a pinion *G*. The latter is secured to the shaft of a motor, *H*, which is preferably a turbine propelled by means of air or steam fed through the pipe *J*. Any suitable means may be used for controlling the motor so as to start, stop, or reverse the winch *E*. Owing to its simplicity and portability many useful applications for the winch should be found in a mine. Mr. Charles Wick, of Bingham Canyon, Utah, has just secured a patent on this improved winch.

AUTOMATIC DRAIN FOR COMPRESSORS.

In certain types of gas compressors it is common practice to inject water either into the compressor or into the discharge pipe therefrom, so as to remove the heat of compression. The accompanying engraving illustrates an apparatus designed to separate the water from the gas automatically, after it has absorbed its quota of heat, and withdraw the water from the separating chamber while maintaining a constant water



AUTOMATIC DRAIN.

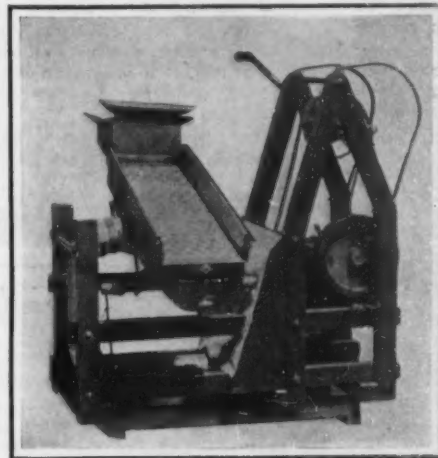
level in the latter, at the same time preventing the loss of any gas withdrawn from the separating chamber in solution in the water. As shown in the illustration, the gas and water, under high pressure, enter, by way of pipe *A*, the separating chamber *B*. The gas passes through pipe *C* to the storage chamber, while the water collects in the bottom of the separating chamber *B*. A pipe connects the chamber *B* with a float chamber *D*, from which a siphon tube *E* leads to the drain. The siphon tube reaches nearly to the bottom of the float chamber *D*, and its lower end is adapted to be opened or closed by means of a float *F* in this chamber. The float *F* is in the form of a cylinder open at the upper end, while within the float at the bottom is a gasket, which is adapted to be pressed against the end of the siphon tube when the float is buoyed up by the water in the float chamber *D*. As the water accumulates in the float chamber *D*, it overflows into the float *F*, and gradually weighs it down until the end of the siphon tube is uncovered. Thereupon the water in the tube is siphoned off until the water level in the float is lowered to such an extent that it will rise again and close the tube. The end of the siphon tube *E* is so far below the level of the water, that there is no possibility of the gas flowing off therethrough, and the water level in the float chamber *D* remains at approximately the level of the upper edge of the float, hence it always covers the inlet pipe connecting the chambers *B* and *D*. This prevents gas from escaping directly from chamber *B* into chamber *D*; but even should any gas escape into chamber *D*, it would be carried off through the pipe *G* to the suction

pipe *H* leading to the compressor. Mr. William D. Mount of Saltville, Va., has secured a patent on this drain for compressors.

PANNING WITHOUT WATER.

BY ROLAND ASHFORD PHILLIPS.

No longer need the patient prospector have water in order to pan his gold-bearing sand and gravel; no longer must he turn his back upon the great stretches



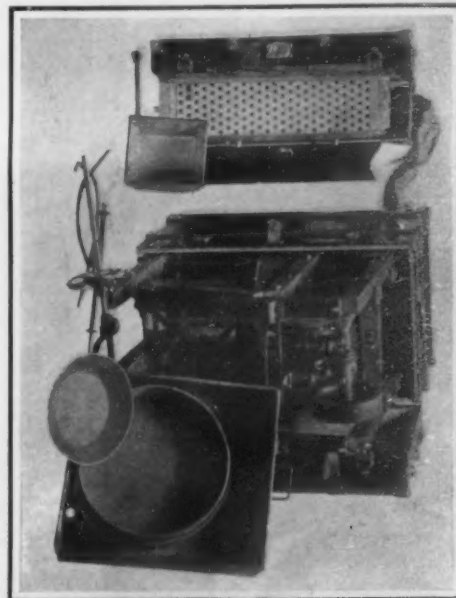
SIDE VIEW OF DRY-GOLD-WASHING MACHINE SET UP READY FOR USE.

of desert because water is not available. For now comes the "dry" machine, using air, which is always available, and which it is claimed will save every bit of "color" that water would save and do the work more expeditiously.

The one crank operates both machine and blower. The sand and gravel are fed in at the hopper on top and allowed to run down the sluice quite in the same manner as in hydraulic sluicing. Here, however, the sluice itself, operated by a simple eccentric, is given a side-shake motion to further separate the particles and to increase the travel of dirt through it.

As may be seen in the illustration, the bottom of this sluiceway contains a series of riffles. These in themselves are unique, and prove to be the vital part of the invention. Instead of projecting above the surface of the sluiceway, as in most sluice boxes, they consist of a series of depressions. Each depressed riffle or pocket is straight across at the upper edge, sloping at the sides, curved at the lower edge, and having the bottom of the pocket so formed sloping in the opposite direction to the inclination of the sluice. The metal forming the bottom of each pocket is continuous at its lower edge with that of the sluice but terminates at the upper end of the pocket at a point vertically below the upper edge of the pocket. The opening thus formed in each pocket is covered with a fine wire screen.

Under the sluiceway is a chamber, air-tight except for the screen-covered openings of the pockets, into which the air is led from the blowing engine. This air, escaping through the upper opening in each pocket, effects an agitation of the gold-bearing material, forcing all the lighter stuff gradually to the top and this, of course, is allowed to run down the

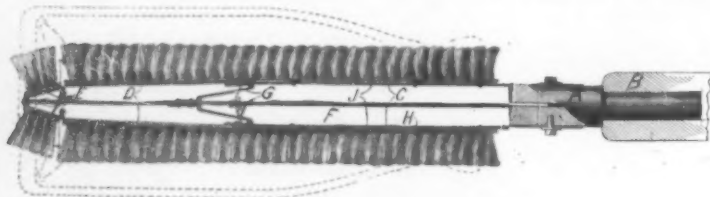


TOP VIEW OF MACHINE, TAKEN APART AND PACKED IN TWO TRUNKS.

incline and is dumped. A clean-up simply means an unlocking of the riffles and the brushing out of the heavy deposit that remains in the multitude of pockets.

The pan shown in the illustration, and furnished with each machine, holds approximately one-twentieth of a cubic yard of gravel. Or, in other words, seven times as much as the ordinary pan. This amount of material can be run through the machine in about five minutes. Afterward the riffles are cleaned, the deposit saved, and a note taken of the location. In his spare moments the prospector can compare notes and find out the most valuable location for serious work. In this manner a man can travel over a great stretch of ground in a remarkably short time, and, when completed, can decide upon the spot that has given him the most "colors."

The advantages of this machine are obvious even



EXPANDING BRUSH FOR CLEANSING BOTTLES.

to those who do not understand mining. What appears to be of the most vital importance is the fact that the prospector can go anywhere and at any time, without fear of not finding water. This means that the countless thousands of acres of desert and arid lands, known to be extremely rich in gold-bearing sands, yet destitute of moisture, can now be easily and thoroughly prospected.

A great number of these machines are in daily operation, especially in the arid regions of Colorado and Nevada, and their success is vouched for by the many prospectors who are only too happy to be free to go where they choose and be rid of the drudgery of the crude pan and primitive methods that previously existed. Not the least advantage of this prospector's machine lies in the fact that it can be readily taken apart and shipped in two trunks, as the illustration shows. Packed thus, and checked as baggage, it will hardly weigh over 200 pounds. Unpacked, and set up, the weight is 180 pounds, and one man can carry one without much trouble.

LOCK FOR ELECTRIC METERS.

A very simple and inexpensive lock has recently been devised for use on electric meters. The lock cannot be opened without breaking a seal, and hence it will reveal any tampering with the meter by an unauthorized person. The lock is particularly adapted for that type of meter in which the cover is secured by two studs on which a pair of keepers are threaded. It comprises a bar, A, which extends across the face of the meter, and is made fast to the two keepers in such a way as to keep them from being unscrewed from the studs. One of the keepers, which is screwed onto the stud B, is provided with an outwardly projecting flange C in which there is a slot. When this keeper has been screwed down against the cover of the meter one end of the bar A is passed through the slot. This end of the bar is bifurcated so as to fit around the stud B, as shown in the drawing. The stud at the other side of the meter passes through an aperture in the bar A, and the keeper D, which is screwed onto the stud, serves to hold the bar against the meter. The keeper D is provided with an aper-



LOCK FOR ELECTRIC METERS.

ture adapted to be brought into register with an aperture in the bar, and when the keeper has been screwed home a seal is passed through the two apertures. The seal consists of a leaden stud such as shown at E. On the projecting shank of the stud a collar of lead is fitted, and, by means of a punch, both collar and shank are flattened and jammed together, while an impression is left on the seal as indicated at F. It will be observed that the locking bar A is curved so as not to cover the volt and ampere readings of the meter. A patent on this improved lock has been granted to Mr. Joseph H. Jackson, of 343 Atlantic Avenue, Brooklyn, N. Y.

EXPANDING BRUSH FOR CLEANSING BOTTLES.

A new form of brush has just been invented, which is so arranged that after it has been introduced into

the bottle, it may be expanded to conform to the shape of the bottle, and thus render the cleansing of the interior more thorough. While the device is particularly adapted for cleansing milk bottles, it may also be employed advantageously for other purposes in which it is necessary to introduce a brush through a small mouth or neck. In our illustration the head D of the brush is attached to the spindle B of the bottle-washing machine. Secured to the head are two flexible strips C of spring metal. Attached to these flexible pieces are a pair of extension strips D, which at their opposite ends are connected by a pair of hinged leaves E. A controlling slide F is attached to the leaves E at one end, while its opposite end enters a slot in the head A. The controlling slide F is connected to the flexible strips C by means of links G. The backs which carry the bristles of the brush are directly secured to the strips D and leaves E; but in the case of the flexible strips C, clips H are provided, which are riveted to the strips C, and are arranged to have sliding engagement with flexible backs J, on which the bristles are secured. The operation of the device is very simple. When the brush is introduced into the bottle, the controlling slide F comes in contact with the bottom of the bottle, and is thus forced back into the slot in the head A. This causes the leaves E and links J to swing open, thereby expanding the brush to conform with the inner contour of the bottle. Messrs. John J. Heywang, Jr., and Minard Slater of 201 West 73d Street, New York city, have secured a patent on this expanding brush.

APPARATUS FOR PURIFYING WATER BY THE INJECTION OF OZONE.

The apparatus shown in the accompanying engraving purifies water by the introduction of ozone through an aspirator. Either direct or alternating current (usually at 110 volts) is taken from the ordinary electric-light circuit and by a transformer is stepped up to about 8,000 volts. This high voltage produces in the ozonizer (a box containing alternate plates of aluminium and micanite) a slight electric discharge, generating ozone from the air drawn through the ozonizer.

The water to be treated flows, under its own pressure, from the city mains through the pipe to its highest point, and in descending draws the ozone, by means of an aspirator, from the ozonizer, the water and ozone thoroughly commingling. This action is continued during the progress of the water in its descent into the glass sterilizer where the ozone ascends in millions of minute bubbles, again coming into intimate contact with all parts of the water and destroying the bacteria therein. The ozonized water then finds an outlet at the top of the sterilizer and may be conducted into any suitable storage receptacle for future use.

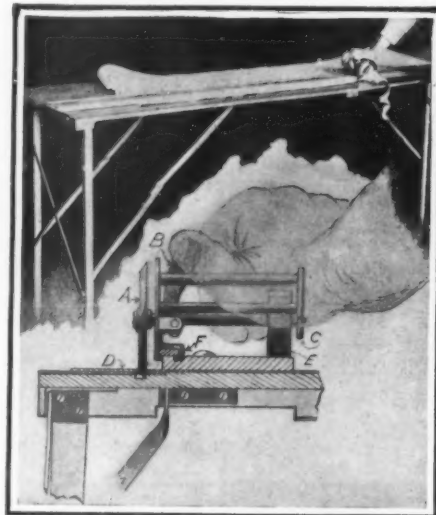
The reason for this destruction of the bacteria by the ozone is very simple. Chemical analysis of the bodies of bacteria shows that they are made up of about 84 per cent of water and 16 per cent of solids. Of these solids more than half is made up of carbon. Ozone, being a concentrated form of oxygen, has a very great affinity for carbon; and the moment a bacillus comes in contact with a bubble of ozonized air the carbon of its body combines with oxygen, and the bacillus is consumed as completely as if it had touched a flame. The product of combustion is carbonic acid, which is partly absorbed by the water, the excess rising to the surface of the water and passing off into the air.

The cost of purifying water by this process is but a small fractional part of a cent per gallon.

With six feet of overhead space the apparatus is capable of purifying 4,000 gallons of water per day, and can be accommodated on a shelf three feet long and one foot wide, the area required being only slightly increased for larger installations.

PAPER HANGER'S TRIMMER.

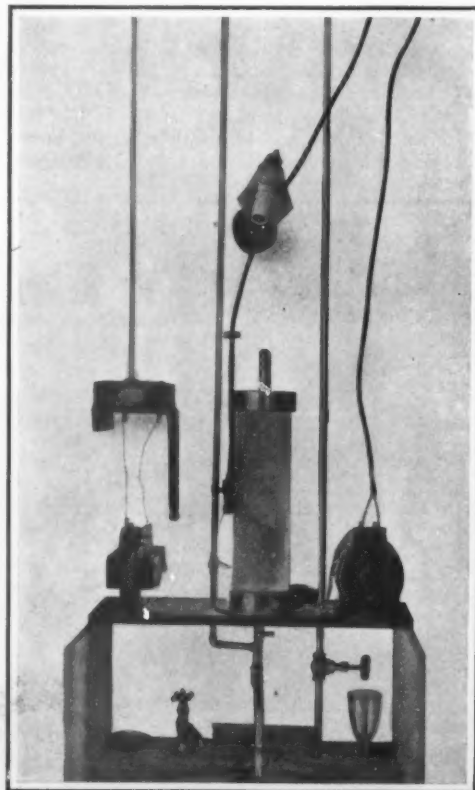
Pictured in the accompanying engraving is a paper hanger's table of improved design with a device mounted thereon, whereby wall paper may be cut and trimmed with clean edges. The table is of the folding type, and is so arranged that when folded it occupies an unusually small compass. The surface of the table is inlaid at one edge adjacent to the cutter with strips of wood of different color, and is provided with a



PAPER HANGER'S TRIMMER.

scale extending at right angles to the inlaid strips. This serves as a gage for cutting the paper to the desired dimensions. The cutter may be removed from the table top when it is desired to fold the table. The sectional view in our engraving shows the details of the cutting device. It consists of a cutting wheel or disk A, which is arranged to be moved laterally by means of a thumb lever B against a straight edge so as to insure a clean cut. The shaft on which the cutter wheel is mounted carries a roller E at the opposite end, which is pressed against the table by the operator when moving the cutter over the paper D. To protect the hand from the rotating parts, a cage C extends over the shaft and roller E, and this is grasped by the hand of the operator with the thumb conveniently placed on the lever B. The carriage on which the cutter is mounted is provided with fingers F, which engage a guide rail mounted on the table top parallel with the straight edge. Were it not for the lever B, which enables the operator to press the cutting disk A against the straight edge, any inequalities in the guide rail would separate the wheel slightly from the straight edge, causing a ragged cut of the paper.

The inventor of this improved paper hanger's trimmer is Mr. E. E. Goble, Brattleboro, Vt.



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SEALED PROPOSALS will be received at the office of the Director of the Census, Washington, D. C., until 2 o'clock, P. M., August 1, 1909, and then publicly opened for furnishing all the labor, materials and work necessary for the construction in lots of 60, 75, 100, or 125 tubing machines and delivering the same complete, free of all charges for transportation, at the Census Building, Washington, D. C. The right is reserved to accept or reject any or all bids in whole or part, to strike out any item or items in the specifications, and to waive any defects. For specifications, blue print drawings, blank proposals, and full information address E. DANA DURAND, Director of the Census, Department of Commerce and Labor, Washington, D. C.

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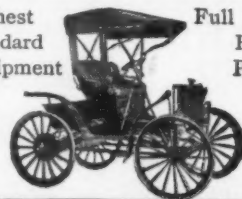
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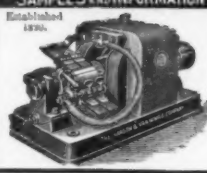
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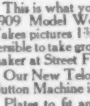
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